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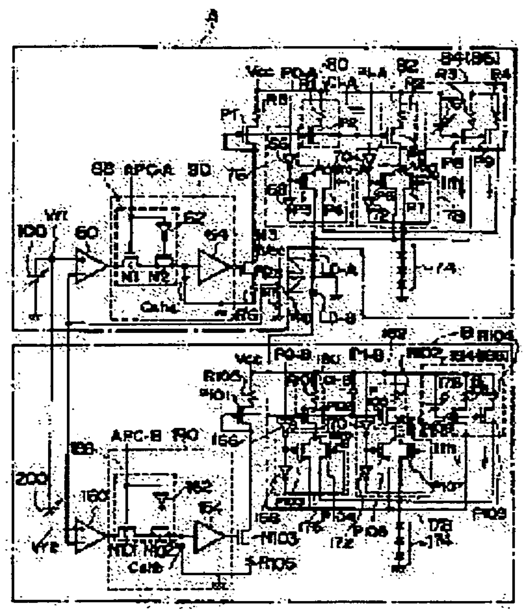
(54) APPARATUS AND METHOD FOR DRIVING LASER DIODE

(57)Abstract:
PROBLEM TO BE SOLVED: To modulate in intensity at a high precision a laser diode, in particular, laser diodes having a common cathode in a laser diode array.
SOLUTION: Between a power supply Vcc and sources of MOS transistors P2 and P5 constituting a plurality of current sources 80 and 82, resistors R1 and R2 are connected, respectively. For the resistors R1 and R2, respective ratios between a ratio W/L of a gate width W to a gate length L of the MOS transistor P2, P5 and the inverse of a resistance value have the same value. In addition, the resistors R1 and R2 have resistance values which allow output resistance values of the respective current sources 80 and 82 viewed from the side of a laser diode LD-A to be capable of driving laser diodes and become sufficiently larger than differential resistance values of the laser diodes in their modulated operations.



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CLAIMS

[Claim(s)]
[Claim 1] After carrying out automatic light control of the laser diode so that the amount of luminescence of a laser diode may become a value corresponding to reference voltage based on the comparison result of a comparison means to measure the reference voltage for the light control of a laser diode, and the detection output of the amount of luminescence of a laser diode, In the laser diode driving gear which modulates a laser beam based on a picture signal While consisting of resistance with which it connected between a maintenance means to hold the output of the comparison means at the time of said automatic light control termination, and the source of an MOS transistor and this MOS transistor, with which common connection of the gate which undergoes the output of this maintenance means respectively was made, touch-down or a power source Two or more current sources which supply the drive current for driving a laser diode, Two or more 1st switching means established between each of two or more of these current sources, and a laser diode, The control means which modulates the drive current supplied to said laser diode by operating alternatively said two or more 1st switching means based on said picture signal, In the MOS transistor which **** and constitutes each of two or more of said current sources, and said resistance The ratio of transistor ratio W/L which is the ratio of gate width W of an MOS transistor and gate length L, and the inverse number of the resistance of said resistance is the same. And the laser diode driving gear characterized by making it the value to which the output resistance value of two or more of said current sources seen from the laser diode side can drive a laser diode, and becomes sufficiently larger than the differential resistance of said laser diode at the time of modulation actuation.
[Claim 2] In a laser diode driving gear according to claim 1, between the gates of an MOS transistor, the touch-down, or the power sources which constitute each of two or more of said current sources The 2nd switching means by which the capacitor which has a capacity smaller than 256 times with the total larger capacity of the capacity between the drain gates of each of said MOS transistor than 16 times is connected, and said maintenance means is connected to the outgoing end of said comparison means in an end, It has the output resistance from which the time constant expressed with a product with the total capacity of the capacity between the drain gates of each of said MOS transistor and the capacity of said capacitor serves as a period which is 1 pixel of a picture signal about. The buffer amplifier with which the input edge was connected to the other end of said 2nd switching means, and the input stage consisted of MOS transistors, It constitutes from a capacitor holding the output of said comparison means by which an end is connected to the input edge of this buffer amplifier, and the other end is grounded. It is the differential mold current switch which consists of two MOS transistors to which common connection of the source is made, it is connected to each output side of two or more of said current sources, and the gate drives each of two or more of said 1st switching means by the complementary signal. One drain of two MOS transistors is connected to said laser diode. this -- The laser diode driving gear characterized by for the volt ampere characteristic of a direct current and the impedance of said abbreviation [laser diode, abbreviation, etc.] in the operating point having been in the drain of another side by carrying out, and connecting a load so that both the drain electrical potential difference at the time of turning on complementary may become equal.
[Claim 3] In a laser diode driving gear according to claim 2, the 2nd switching means which constitutes said maintenance means consists of MOS transistors. In the PN junction of the source drain of the MOS transistor which constitutes said 2nd switching means The PN-junction area of the substrate of the P-channel MOS transistor connected to a power-source side, and the source drain of this transistor, Said 2nd switching means has a ratio with the PN-junction area of the substrate of the N-channel MOS transistor connected to the earth side, and the source drain of this transistor in an OFF state. The laser diode driving gear characterized by being set up so that it may change in the direction in which the amount

of luminescence of this laser diode decreases with time amount while said laser diode is emitting light.
[Claim 4] It is constituted so that a single photodetection means to detect the amount of luminescence of a laser diode may be shared with two or more laser diode driving gears. And so that the amount of luminescence of two or more laser diodes may become a value corresponding to reference voltage based on the comparison result of a comparison means to measure the reference voltage for the light control of a laser diode, and the detection output of said photodetection means In the drive approach of the laser diode which carries out light control of two or more laser diodes by time sharing It gives a comparison means of a laser diode driving gear to drive one laser diode. the reference voltage for the light control of any one laser diode in said two or more laser diodes -- this -- To each comparison means of a laser diode driving gear to drive other remaining laser diodes, respectively The value which added the difference with the offset voltage which each quantity of light control system including each comparison means of a laser diode driving gear to drive the offset voltage which a quantity of light control system including a comparison means by which this reference voltage is given to said reference voltage has, and said each of other remaining laser diode has is made into reference voltage. The drive approach of the laser diode characterized by giving.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the drive approach of a suitable laser diode driving gear to use it for the image formation equipment which forms an image in a photo conductor, and a laser diode, changing the luminescence quantity of light of a laser diode using a laser diode array.
[0002]
[Description of the Prior Art] An image output is accelerated, and the semiconductor laser component of wavelength which is different also in optical communication by forming the optical output of semiconductor laser components, such as a laser diode, into a multi-beam in a recent-years, for example, laser, xerography is made on the same chip, and the attempt which raises an optical-communication rate by multiplexing of wavelength is made.
[0003]
[Problem(s) to be Solved by the Invention] By the way, generally as for the laser diode array in which two or more laser diodes currently used for such an application were formed on the same substrate, the cathode is connected in common. This is based on that the equivalent series resistance of a laser diode is lowered for those who used the N type substrate, and a high speed drive can be performed, and the reason for being advantageous also in respect of the yield.
[0004] The current source of a discharge mold is required to drive the laser diode array to which such a cathode was connected in common on the other hand. Conventionally, MESFET of a bipolar transistor or a compound semiconductor has been used for the current source which drives a laser diode. Although a PNP transistor is needed for constituting from a bipolar transistor when it is going to make a discharge mold current source from these processes, a high-speed drive cannot be performed in the lateral mold PNP transistor usually used.
[0005] On the other hand, the vertical mold PNP transistor in which a high-speed drive is possible has a complicated manufacture process, and it is expensive. Moreover, even if the mobility of a hole is small in the case of a compound semiconductor and the P channel mold FET is made, there will be no merit using a compound semiconductor. therefore, to carry out the high-speed drive of the laser diode by the current source of a discharge mold For example, the current switch 12 in which the high-speed switching which consists of transistors Q1 and Q2, and the discharge mold current source 10 which consists of resistance R1 and R2, and which is not switched and transistors Q3 and Q4 as shown in drawing 3 R> 3 is possible is connected to a serial. It stops that make the outflow current from a current source 10 flow into a transistor Q6 side, and a laser diode LD HE current flows by turning on the transistor Q3 of the current switch 12. It is made for a current to flow from a current source 10 to a laser diode LD through diode D1 by turning off the transistor Q3 of the current switch 12 (JP,4-240787,A, JP,6-139607,A).
[0006] It can constitute from this method like so that the output capacitance of a discharge mold current source may not influence the modulation rate of the output of a laser diode by it not being necessary to switch a discharge mold current source with a slow working speed and, and connecting a discharge mold current source with a current switch through an inductance.
[0007] However, as shown to drawing 4 in this method, what carried out parallel connection of the current sources Q17 and Q18 by which series connection was carried out to two or more current switches 22 and 24 and these is connected to the discharge mold current sources 20 and 26 at a serial, and when intensity modulation of the output of a laser diode is carried out by driving alternatively two or more current switches 22 and 24 and the output of a laser diode is made low, the problem that a noise increases arises.
[0008] Namely, the source 26 of a bias current where, as for the current source shown in drawing 4 , the

threshold current of a laser diode LD was set up, It is based on the suction current I of the suction mold current source 22. The output current The discharge mold current source 20 of 3xI, The suction mold current source 22 of 1xI and an absorption current use two suction mold current sources of the suction mold current source 24 of 2xI, and the suction current constitutes the current source in which the intensity modulation of 4 level of 0, 1xI, 2xI, and 3xI is possible. In drawing 4 , the threshold current is supplied to the laser diode LD by the source 26 of a bias current. In case a semiconductor laser component drives a threshold current here, it says the current which flows for a semiconductor laser component in the point which shifts to a laser oscillation condition from a spontaneous-emission condition to it. The case where it would absorb by inputting the control signals 1 and 2 which control transistors Q12 and Q14 to be in switch-on or non-switch-on, respectively, and the transistors Q12 and Q14 of the mold current sources 22 and 24 will be in non-switch-on is considered. In this case, since discharge current 3xI which flows out of the discharge mold current source 20 has the transistors Q12 and Q14 of two suction current sources 22 and 24 in non-switch-on, it flows to a laser diode LD altogether.
[0009] Next, if it absorbs with a control signal 2 and the transistor Q14 of the mold current source 24 is made into switch-on, since the absorption mold current source 24 will drive, to a laser diode LD, the current I which absorbed from discharge current 3xI and deducted absorption current 2xI by the mold current source 24 flows. By the way, considering the shot noise generated with a transistor at this time, it will absorb with control signals 1 and 2, and the transistors Q12 and Q14 of the mold current sources 22 and 24 will be in non-switch-on, and when discharge current 3xI which flows out of the discharge mold current source 20 flows altogether to a laser diode LD, a S/N ratio becomes 3 rootI/root3 time by root (3xI).
[0010] However, absorb with a control signal 2 and the transistor Q14 of the mold current source 24 is made into switch-on. When only 1xI of the discharge current 3xI flows to a laser diode LD, The discharge mold current source 20 side a shot noise since there is no correlation in a noise at the suction mold current source 24 side -- the square of root by the side of the discharge mold current source 20 (3xI) -- ** -- it absorbs, and becomes square root root (5xI) of sum 5I with the square of root by the side of the mold current source 24 (2xI), and the S/N ratio at this time falls to rootI/root5 time. When this method performs intensity modulation so that this may show, a S/N ratio falls, so that especially level is small. image quality [in / in this / a laser xerography] -- or it becomes a problem by the laser beam communication link of a multiple value etc. There was a problem in the thing which was constituted from these reasons by the NPN transistor of a bipolar transistor, and N channel mold field-effect transistor of MESFET and which absorb and constitutes a discharge mold current source using a mold current source.
[0011] On the other hand, the laser driver by MOSFET is indicated by JP,7-335957,A and JP,8-293837,A. If it is CMOS, it is possible to make both a PMOS transistor and an NMOS transistor, and moreover, the mutual conductance gm near [in recent years] a bipolar transistor has come to be obtained by gate length's ****-ization.
[0012] The technical problem 1 and the inclination for which the drain current of an MOS transistor depends [time] on the electrical potential difference between the drain sources in a pinch-off field by gate length's ****-ization became large. If the current supplied to a laser diode changes when a constant current source is constituted and it operates it by the MOS transistor, the terminal voltage of a laser diode will change, as a result, the current value of a current source is changed, and this has a problem of the output current of a current source stopping being proportional to the input data in intensity modulation correctly.
[0013] The configuration of the laser diode driving gear which has the discharge mold current source which used PMOS for technical-problem 2 drawing 5 , and in which intensity modulation is possible is shown. In this drawing, intensity modulation becomes possible by controlling the current switches 34 and 35 on which the threshold current Ith of a laser diode LD was set by the source 30 of a bias current, and the discharge mold current source 32 (discharge current 1xI) which carried out weighting, and the discharge mold current source 33 (discharge current 2xI) were connected to the discharge mold current sources 32 and 33 by control signals P0 and P1. The gate potential of the PMOS transistor which constitutes each discharge mold current sources 32 and 33 for intensity modulation The CMOS switch 38 which constitutes a sample hold circuit 37 before starting a modulation is turned ON by making a control signal CS high-level. It is determined by carrying out negative feedback of the output of the photodiode PD which received the output light of a laser diode LD to a comparator 36, and the CMOS switch 38 is turned OFF, the value is held to Capacitor Csh, and it considers as the control voltage Vsh at the time of a modulation. Since the gate input impedance is high, direct continuation especially of the MOSFET can be carried out to the terminal of the capacitor Csh by which the control voltage at the time of a modulation is held as shown in

drawing 5 .
[0014] However, conventionally, by binary Pulse Density Modulation, when having not become a problem performs intensity modulation, it becomes a problem. For example, drain electrical potential difference Vdr1 of the PMOS transistor M1 which constitutes a current source 33 if a control signal P1 is made into a low level from high level in the example of drawing 5 It goes up from touch-down potential to the terminal voltage VLD of laser. This drain electrical potential difference Vdr1 Change raises control **** Vsh through the capacity between the drain gates of the transistor M1 which constitutes a current source 33. Consequently, the output current value of current sources 32 and 33 decreases. Thus, by opening and closing a current switch for intensity modulation, control voltage Vsh changed and there was a trouble of the output current stopping corresponding correctly to modulation data.
[0015] while constituting the current source which supplies a drive current to technical-problem 3 laser diode from an MOS transistor, if the sample hold circuit which holds current source control voltage during a modulation period is also constituted from an MOS transistor, current stability can be boiled markedly and it can improve. In the laser xerography which uses especially a laser diode array and performs high-speed writing, the merit is large. Since there is only one photodiode which receives the output light of a laser diode to two or more laser diodes, the light control before the modulation of a laser diode array has usually set up the quantity of light by time sharing. By time sharing, it divides roughly as an approach of carrying out light control, and there are two. One is the method which changes the laser diode which carries out light control for every line, and since the time amount to the next light control is long, DORUPU (voltage variation) of the current source control voltage currently held to the capacitor during the modulation period poses a problem, so that there are many laser diodes which should be carried out light control, although the time amount which the light control occupied in one line takes is not different from single laser.
[0016] It is the approach one [one more] approach carries out light control of all the laser diodes into one line each time, and since light control of all the laser diodes is carried out for every line in this case and the capacitor for sample hold of a sample hold circuit is recharged, DORUPU of a sample hold circuit does not become a problem.
[0017] However, the time amount of the light control occupied in one line must become so long that there are many laser diodes, must shorten the modulation period for writing in an image that much, and causes the fall of writing speed. Therefore, in order not to reduce the engine performance of a laser xerography, it is necessary to improve the DORUPU property of a sample hold circuit.
[0018] By the conventional single laser, moreover, only in the case of Pulse Density Modulation, since it was always fixed, as for the problem of DORUPU, quantity of light fluctuation of the scanning direction of laser did not become a big problem on vision by the application to a laser xerography for every scan. However, when a laser diode was changed for every one scan and light control of a laser diode was performed using the laser diode array put in order in the scanning direction of laser, and the direction of vertical scanning of a right angle, the timing of light control differed with the laser diodes which a laser diode array adjoins, and since slight DORUPU affected image quality, DORUPU needed to be controlled further. An MOS transistor can make easily the sample hold circuit which was extraordinarily excellent in the DORUPU property compared with the bipolar transistor.
[0019] By the way, a CMOS switch will be used, if it is usually a CMOS process as shown in a sample hold circuit at drawing 6 (a). This is for making it not dependent [the on resistance of a switch] on the terminal voltage of a switch. In drawing 6 , an NMOS switch, drawing 6 (c), and (e) show the sample hold circuit where drawing 6 (a) used the CMOS switch and, as for a switch with a CMOS noise canceller, drawing 6 (d), and (f), drawing 6 R> 6 (b) used the switch with an NMOS noise canceller, respectively. In drawing 6 , 100-105 are noise cancellers.
[0020] Generally the transistor size of the PMOS transistor of a CMOS switch and an NMOS transistor is decided in two viewpoints. By the case where a switching noise (leakage lump of the charge produced through capacity coupling from the gate) is made into min, one designs the gate width of a PMOS transistor and an NMOS transistor equally. Since the feed through from the gate of a PMOS transistor and an NMOS transistor is reversed polarity when it carries out like this, the switching noise produced to a PMOS transistor and an NMOS transistor offsets each other. however, a switching noise is strictly offset by this method -- the breadth of the inversion layer under the gate -- a PMOS transistor and an NMOS transistor -- it is -- etc. -- about [of the becoming supply voltage to spread] -- it is only at one half of the times, and on other electrical potential differences, since the feed through by the inversion layer of CMOS switch both ends differs with a PMOS transistor and an NMOS transistor, each other is not offset. For this reason, in order to connect to the terminal by the side of Capacitor Csh the MOS transistor of the

dummy which made gate width of an MOS transistor one half or to raise the effectiveness of noise cancellation further not to be based on supply voltage but reduce a switching noise, connecting the MOS transistor of the dummy which made gate width one half also between comparator outputs is also performed.

[0021] Another viewpoint sets to W gate width of the gate of the PMOS transistor which constitutes a CMOS switch from a case where the supply voltage dependency of on resistance is made small, and an NMOS transistor, sets gate length to L, and designs the ratio (transistor ratio) of W/L by the inverse number ratio of the mobility of a hole and an electron. If it carries out like this, the value of the on resistance of a PMOS transistor when the potential of the both ends of a CMOS switch is in agreement with supply voltage, and the on resistance of an NMOS transistor when the potential of CMOS switch both ends is in agreement with touch-down potential will become equal. With a CMOS switch, since a low switching noise is required as usually low on resistance, the PMOS transistor and NMOS transistor which constitute a CMOS switch are min, and equal channel length designs them. For this reason, even if it designs in which viewpoint, the width of face of a PMOS transistor and an NMOS transistor is equal, or the gate width of a PMOS transistor becomes large. Consequently, with a PMOS transistor and an NMOS transistor, omit, and supposing the PN-junction leak per unit area is equal Since N substrate is connected to the power source with the PMOS transistor when it is left, while the sample hold circuit has been a HOLD status, Since leakage current flows into the capacitor Csh for sample hold through the PN junction of this N substrate and P layers which are source drains and P substrate is grounded with the NMOS transistor, Leakage current flows out of the capacitor Csh for sample hold through the PN junction of this P substrate and N layer which is a source drain. Consequently, the output of a sample hold circuit is converged on the electrical potential difference of l/2 or more supply voltage, as the leak from the PN junction of the source drain of an NMOS transistor and a PMOS transistor shows to drawing 7 . When the NMOS transistor of a CMOS switch was driven on this electrical potential difference, there was a problem that an excessive current flowed to a laser diode and destroyed a laser diode.

[0022] In the automatic light control of a technical-problem 4 laser-diode array, as already stated, light control is carried out by time sharing to two or more laser diodes using one photodiode. Therefore, the automatic light control of each laser diode should just compare with one reference voltage corresponding to the desired value of the amount of luminescence of a laser diode one photodiode output which detects the optical output of a laser diode by the comparator as an error detection means. However, since offset differed separately, two or more comparators used in fact for automatic light control needed to be doubled with each comparator, and whenever the reference voltage of each comparator changed reference voltage, they needed to adjust it for every laser diode.

[0023] This invention is made in view of such a situation, and it sets it as the 1st purpose to offer the laser diode driving gear which aimed at improvement in intensity modulation precision.

[0024] Moreover, it sets it as the 2nd purpose to offer the laser diode driving gear which can prevent that the laser diode under luminescence damages this invention according to an overcurrent even if a maintenance means (sample hold circuit) to hold the control voltage which controls the drive current of a laser diode by malfunctions, such as a halt of a control system, continues the maintenance condition of control voltage.

[0025] Furthermore, this invention sets it as the 3rd purpose to offer the drive approach of the laser diode which can control the quantity of light of two or more laser diodes of all only by adjusting one reference voltage for setting the luminescence quantity of light of a laser diode as desired value with high precision.

[0026]

[Means for Solving the Problem] In order to attain the 1st purpose invention according to claim 1 After carrying out automatic light control of the laser diode so that the amount of luminescence of a laser diode may become a value corresponding to reference voltage based on the comparison result of a comparison means to measure the reference voltage for the light control of a laser diode, and the detection output of the amount of luminescence of a laser diode, In the laser diode driving gear which modulates a laser beam based on a picture signal While consisting of resistance with which it connected between a maintenance means to hold the output of the comparison means at the time of said automatic light control termination, and the source of an MOS transistor and this MOS transistor, with which common connection of the gate which undergoes the output of this maintenance means respectively was made, touch-down or a power source Two or more current sources which supply the drive current for driving a laser diode, Two or more 1st switching means established between each of two or more of these current sources, and a laser diode, The control means which modulates the drive current supplied to said laser diode by operating alternatively said two or more 1st switching means based on said picture signal, In the MOS transistor which **** and

constitutes each of two or more of said current sources, and said resistance The ratio of transistor ratio W/L which is the ratio of gate width W of an MOS transistor and gate length L, and the inverse number of the resistance of said resistance is the same. And it is characterized by making it the value to which the output resistance value of two or more of said current sources seen from the laser diode side can drive a laser diode, and becomes sufficiently larger than the differential resistance of said laser diode at the time of modulation actuation.

[0027] Each of two or more current sources which supply the drive current for driving a laser diode in the laser diode driving gear of the above-mentioned configuration Resistance is connected and constituted, respectively between the source of an MOS transistor and this MOS transistor, touch-down, or a power source. In the MOS transistor which constitutes each of two or more of said current sources, and said resistance, the ratio of transistor ratio W/L and the inverse number of the resistance of said resistance is the same. And since it was made the value to which the output resistance value of two or more of said current sources seen from the laser diode side can drive a laser diode, and becomes sufficiently larger than the differential resistance of said laser diode at the time of modulation actuation In case intensity modulation of the drive current of a laser diode is carried out, while being able to control output fluctuation of the drive current by fluctuation of the electrical potential difference between terminals of a laser diode and being able to aim at improvement in the intensity modulation precision of a laser diode It becomes possible to correspond also to a laser diode with the large electrical potential difference between terminals of a laser diode. What is necessary is just to adjust this resistance so that the output resistance value of a current source may become 16 or more times of this at least when performing intensity modulation (the gradation for several ohms - 10 ohms of numbers (for example, 16 gradation) of the dynamic resistance of the laser diode near a threshold current) in the case of several 10mW infrared laser actually marketed.

[0028] Moreover, invention according to claim 2 is set to a laser diode driving gear according to claim 1. Between the gates of an MOS transistor, the touch-down, or the power sources which constitute each of two or more of said current sources The 2nd switching means by which the capacitor which has a capacity smaller than 256 times with the total larger capacity of the capacity between the drain gates of each of said MOS transistor than 16 times is connected, and said maintenance means is connected to the outgoing end of said comparison means in an end, It has the output resistance from which the time constant expressed with a product with the total capacity of the capacity between the drain gates of each of said MOS transistor and the capacity of said capacitor serves as a period which is 1 pixel of a picture signal about. The buffer amplifier with which the input edge was connected to the other end of said 2nd switching means, and the input stage consisted of MOS transistors, It constitutes from a capacitor holding the output of said comparison means by which an end is connected to the input edge of this buffer amplifier, and the other end is grounded. It is the differential mold current switch which consists of two MOS transistors to which common connection of the source is made, it is connected to each output side of two or more of said current sources, and the gate drives each of two or more of said 1st switching means by the complementary signal. One drain of two MOS transistors is connected to said laser diode. this -- It is characterized by for the volt ampere characteristic of a direct current and the impedance of said abbreviation [laser diode, abbreviation, etc.] in the operating point having been in the drain of another side by carrying out, and connecting a load so that both the drain electrical potential difference at the time of turning on complementary may become equal.

[0029] In the laser diode driving gear of the above-mentioned configuration, two or more current sources, respectively It connects with a laser diode through the 1st switching means which is the differential mold current switch which consists of two MOS transistors. In case intensity modulation of the drive current which drives a laser diode by operating the 1st switching means of the above alternatively is carried out Enough from the total capacity of the capacity between the drain gates of the MOS transistor which constitutes said current source even if it changes the level of the modulating signal which is a complementary signal which drives each 1st switching means of the above The capacitor which has a large capacity is connected between the gates of an MOS transistor, the touch-down, or the power sources which constitute each of two or more current sources. and the volt ampere characteristic of the laser diode and direct current to the drain of one MOS transistor of two MOS transistors which constitute each of the 1st two switching means and the impedance in the operating point -- abbreviation -- by connecting an equivalent load Since the voltage variation of the gate of the MOS transistor which constitutes each of two or more current sources can be controlled, improvement in the precision of intensity modulation can be aimed at.

[0030] In order to attain the 2nd purpose invention according to claim 3 In a laser diode driving gear according to claim 2, the 2nd switching means which constitutes said maintenance means consists of MOS

transistors. In the PN junction of the source drain of the MOS transistor which constitutes said 2nd switching means The PN-junction area of the substrate of the P-channel MOS transistor connected to a power-source side, and the source drain of this transistor, Said 2nd switching means has a ratio with the PN-junction area of the substrate of the N-channel MOS transistor connected to the earth side, and the source drain of this transistor in an OFF state. While said laser diode is emitting light, it is characterized by being set up so that it may change in the direction in which the amount of luminescence of this laser diode decreases with time amount. As a configuration of the MOS transistor of the 2nd switching means, there are drawing 6 (a) thru/or (f), and it can be used, even if it constitutes so that the NMOS transistor in this drawing (b), (d), and (f) may be further permuted by the PMOS transistor. In addition, it is also possible to float from a power source and touch-down, to make the substrate of a PMOS transistor or an NMOS transistor into another potential, and to operate it respectively.

[0031] Since the maintenance electrical potential difference of a maintenance means changes in the direction in which the amount of luminescence of a laser diode decreases with the passage of time within a modulation period even if the condition that luminous laser should be held by halt of a control system etc. in the laser-diode driving gear of the above-mentioned configuration, and the output of a comparison means should be held by the maintenance means continues at the outside of a modulation period, a laser diode can -ed ** according to an overcurrent, or it can prevent that the irradiated plane of a laser diode wins popularity in damage.

[0032] In order to attain the 3rd purpose invention according to claim 4 It is constituted so that a single photodetection means to detect the amount of luminescence of a laser diode may be shared with two or more laser diode driving gears. And so that the amount of luminescence of two or more laser diodes may become a value corresponding to reference voltage based on the comparison result of a comparison means to measure the reference voltage for the light control of a laser diode, and the detection output of said photodetection means In the drive approach of the laser diode which carries out light control of two or more laser diodes by time sharing It gives a comparison means of a laser diode driving gear to drive one laser diode. the reference voltage for the light control of any one laser diode in said two or more laser diodes -- this -- To each comparison means of a laser diode driving gear to drive other remaining laser diodes, respectively The value which added the difference with the offset voltage which each quantity of light control system including each comparison means of a laser diode driving gear to drive the offset voltage which a quantity of light control system including a comparison means by which this reference voltage is given to said reference voltage has, and said each of other remaining laser diode has is made into reference voltage. It is characterized by giving.

[0033] By the drive approach of the laser diode of the above-mentioned configuration It gives a comparison means of a laser diode driving gear to drive one laser diode. one reference voltage for the light control of any one laser diode in two or more laser diodes -- this -- To each comparison means of a laser diode driving gear to drive other remaining laser diodes, respectively The value which added the difference with the offset voltage which each quantity of light control system including each comparison means of a laser diode driving gear to drive the offset voltage which a quantity of light control system including a comparison means by which this reference voltage is given to said one reference voltage has, and said each of other remaining laser diode has is made into reference voltage. It can give and the rest can perform quantity of light adjustment of all laser diodes with high precision by adjusting only the one above-mentioned reference voltage.

[0034]

[Example] The gestalt of operation of this invention is explained with reference to a drawing. The configuration of the laser diode driving gear concerning the gestalt of operation of this invention is shown in drawing 1 . The laser diode driving gear concerning the gestalt of this operation forms only one photo detector PD as a photodetection means to detect laser diode LD-A and the output light of LD-B to two laser diode LD-A and LD-B, and to output a photocurrent, and it is constituted so that automatic light control of laser diode LD-A and LD-B may be carried out by the drive circuit A and the drive circuit B and intensity modulation may be carried out by time sharing. Since the configuration of two drive circuits A and B is the same, the drive circuit A is explained here. In drawing 1 R> 1, common connection of the cathode of laser diode LD-A and LD-B is made, and it is grounded. The current sources 80 and 82 with weight are connected through the current switches 76 and 78 corresponding to the 1st switching means of this invention in the anode of laser diode LD-A. From the resistance R1 to which the current source 80 was connected between the source of the PMOS transistor P2 and the PMOS transistor P2, and a power source Vcc, the current source 82 consists of resistance R2 connected between the source of the PMOS transistor P5 and the PMOS transistor P5, and a power source Vcc, respectively. Weighting of the output

current ratio of current sources 80 and 82 is carried out to 1:2, and transistor ratio W/L (W is gate width and L is gate length.) of the PMOS transistors P2 and P5 is set up so that the output current of a current source 80 may be set to 1xI and the output current of a current source 82 may be set to 2xI on the basis of the output current of a current source 80.

[0035] Moreover, the resistance of the resistance R1 and R2 which forms the output resistance of current sources 80 and 82 The ratio of the inverse number and transistor ratio W/L of the PMOS transistors P2 and P5 is equal respectively. The resistance of the output resistance of the current sources 80 and 82 seen from the laser diode LD-A side can drive laser diode LD-A. And enough from the differential resistance of laser diode LD-A at the time of after [a modulation] actuation When performing intensity modulation of the value which becomes large, for example, 16 gradation, one 256 times [16 to] the value of said differential resistance of this is chosen. It is because the margin of supply voltage is only lost by the voltage drop in resistance R1 and R2 even if it is about 40dB which made the upper limit into 256 times here and the S/N ratio of a laser diode increases it more than this with an electric-eye output by various noise sources.

[0036] The current switch 76 consists of two PMOS transistors P3 and P4 and inverters 66 and 68 by which the source is connected to the drain of the PMOS transistor P2 which common connection is made and constitutes a current source 80.

[0037] Moreover, the current switch 78 consists of two PMOS transistors P6 and P7 and inverters 70 and 72 by which the source is connected to the drain of the PMOS transistor P5 which common connection is made and constitutes a current source 82. The current switch 76 and the current switch 78 are differential mold current switches which the gate of the PMOS transistors P3 and P4 or the PMOS transistor P6, and P7** drives by the complementary signal, respectively.

[0038] The drain of the PMOS transistors P3 and P6 of the current switches 76 and 78 is connected to the anode of laser diode LD-A, and the drain of the PMOS transistors P4 and P7 of the current switches 76 and 78 is connected to the end of a dummy load 74, respectively. The other end of a dummy load 74 is grounded.

[0039] Through the inverter 66, through inverters 66 and 68, it is constituted by the gate of the PMOS transistor P3 of the current switch 76 at the gate of the PMOS transistor P4, respectively so that control signal P0-A may be inputted. Moreover, through the inverter 70, through inverters 70 and 72, it is constituted by the gate of the PMOS transistor P6 of the current switch 78 at the gate of the PMOS transistor P7, respectively so that control signal P1-A may be inputted. Switching control of the current switches 76 and 78 is carried out by control signal P0-A and P1-A, and they carry out intensity modulation of laser diode LD-A. It prevents that the control voltage which controls the drive current of laser diode LD-A which capacitor Ci-A holds in case a switch turns off by driving complementary with inverters 68 and 72 shifts transitionally the gate of each PMOS transistors P3, P4, P6, and P7 which constitute the current switches 76 and 78 by the feed through of a switch control signal.

[0040] It is possible it to increase intensity modulation level by increasing a current source with weight further with the gestalt of this operation, including level zero, although modulation level is the intensity modulation of 4 level. Moreover, since a drive circuit is produced by the CMOS process in the laser diode driving gear concerning the gestalt of this operation It is easy to make current sources 80 and 82 and the discharge mold current source which constituted the current switches 76 and 78 using a PMOS transistor. It compares with the conventional discharge mold current source which the cathode was connected in common like especially a laser diode array, and combined the absorption mold current source and the discharge mold current source when a discharge mold current source was required. At a low noise and a high speed And the drive circuit, as a result laser diode driving gear of low cost can be obtained.

[0041] Furthermore, the source 84 of a bias current which consists of the source 76 of good transformation, a PMOS transistor P8, and resistance R3 is connected to the anode of laser diode LD-A, and it is constituted so that a threshold current Ith may always be supplied to laser diode LD-A by the source 84 of a bias current.

[0042] Moreover, the source 86 of a bias current which consists of the source 76 of good transformation, a PMOS transistor P9, and resistance R4 is connected to the end of a dummy load 74, and it is constituted so that a bias current may always be supplied also to a dummy load 74 by the source 86 of a bias current. The source 86 of a bias current is to change the terminal voltage of a dummy load 74 similarly, and for fluctuation of potential Vdr0-A in the output node of current sources 80 and 82 and Vdr1-A make it min in all intensity modulation fields, when intensity modulation is carried out and the terminal voltage of laser diode LD-A changes. Therefore, omitting with the precision prescribe of intensity modulation is also possible.

[0043] When a dummy load 74 turns on the current switches 76 and 78 and turns off, the volt ampere characteristic of a direct current and the impedance in the operating point are constituted using diode, resistance, a capacitor, and an inductance as laser diode LD-A, abbreviation, and a load that becomes equal so that fluctuation may become [potential Vdr0-A in the output node of current sources 80 and 82, and Vdr1-A] small also transitionally also in direct current. Therefore, when the current switches 76 and 78 are switched on and turned off, fluctuation of potential Vdr0-A in the output node of current sources 80 and 82 and Vdr1-A is controlled.

[0044] PD is a photodiode which functions as a photodetection means to detect the amount of luminescence of laser diode LD-A, for example, it is mounted in a package with two or more laser diodes, and the PIN photodiode which receives the light from the tooth back of a laser diode is used. Photodiode PD is grounded through the resistance R7 as a current potential conversion means whose anode changes into an electrical potential difference the photocurrent outputted by Photodiode PD, and the cathode is connected to the power source Vcc.

[0045] 60 is a comparator corresponding to the comparison means of this invention which compares the electrical potential difference according to the luminescence quantity of light of laser diode LD-A in which current potential conversion was carried out by resistance R7 with the reference voltage Vr1 set up by the reference supply 100 which generates the reference voltage which is the desired value of the luminescence quantity of light of laser diode LD-A, and outputs the electrical potential difference according to the deflection. This comparator is constituted by the operational amplifier. Reference voltage Vr1 is set up by the reference supply 100, measuring the luminescence quantity of light of laser diode LD-A with an actinometer at the time of the automatic light control of laser diode LD-A. However, it becomes the value which the offset voltage of the quantity of light control system which contains a comparator 60 in the electrical potential difference which produces the reference voltage actually set up since an electrical potential difference is changed by the leakage lump from the gate signal of the NMOS transistors N1 and N2 in case the comparator consists of operational amplifiers strictly, a comparator input has offset and it turns off with a switch 62 further to the both ends of resistance R6 with the photocurrent output of Photodiode PD joined. Although it is better for especially the input offset voltage of a comparator to prepare reference voltage separately in order to raise the precision of the light control of a laser diode, since it varies for every comparator, it is complicated. So, offset uses not being influenced greatly for the drive conditions of a laser diode, and to one reference voltage Vr1, it consists of gestalten of this operation so that the difference of the input offset voltage of a comparator 60,160 may be added and the reference voltage Vr2 supplied to the comparator 160 of another drive circuit B may be impressed. Namely, as for reference voltage Vr2, only the difference of the input offset voltage of a comparator 60,160 is set up. Both laser diode LD-A and the luminescence quantity of light of LD-B can be set up with a sufficient precision in a high precision only by adjusting the reference voltage (the gestalt of this operation reference voltage Vr1 of a comparator 60) which is one side by this. Although the number of laser diode drive drive circuits (laser diode driving gear) is two with the gestalt of this operation, it is the same when this carries out light control of the n laser diodes by time sharing by n laser diode drive circuits. that is So that the photodiode PD which is a single photodetection means to detect the luminescence quantity of light of a laser diode may be shared with other laser diode driving gears With two or more laser diode driving gears l, --, n (n>=2) which have a comparator as an error detection means to measure the reference voltage for the light control of the constituted laser diode, and the detection output of said photodetection means [two or more laser diodes 1, --, when carrying out light control of the n (n>=2) by time sharing] The reference voltage 1 for the light control of a laser diode 1 is given to the comparison means (comparator) of the laser diode driving gear 1. What is necessary is just to give the value which added the difference of the input offset voltage of the comparison means of the laser diode driving gear 1, and the input offset voltage of the comparison means of the laser diode driving gear n to reference voltage 1 as reference voltage n to the laser diode driving gear n.

[0046] The outgoing end of a comparator 60 minds the switch 88 corresponding to the 2nd switching means of this invention, and is the input edge and Capacitor Csha of the buffer amplifier 64. It connects with the end and is Capacitor Csha. The other end is grounded.

[0047] A switch 88, the buffer amplifier 64, and capacitor Csha A maintenance means 90 to hold the control voltage for controlling the drive current of laser diode LD-A which is the output voltage of the comparator 60 at the time of automatic light control termination is constituted. The maintenance means 90 is equivalent to the maintenance means of this invention.

[0048] The switch 88 has the NMOS transistor N1, the NMOS transistor N2 for noise cancellation which between source drains connected too hastily and was connected between the NMOS transistor N1 and the

input edge of the buffer amplifier 64, and the inverter 62. The source of the NMOS transistor N1 is connected to the outgoing end of a comparator 60, and the drain is connected to the source of the NMOS transistor N2. The drain of the NMOS transistor N2 is connected to the input edge of the buffer amplifier 64. The NMOS transistor N1 and channel length are equal, and gate width is designed by the NMOS transistor N2 so that it may become half.

[0049] Moreover, control signal APC-A which controls switching of a switch 88, respectively is directly inputted into the gate of the NMOS transistor N2 through an inverter 62 at the gate of the NMOS transistor N1. In addition, as for the control signal to the gate of the NMOS transistors N1 and N2, it is desirable to consider as the complementary signal which started within limits which do not influence actuation and made falling late in order to control a switching noise as much as possible.

[0050] Moreover, since the switch 88 consists of only NMOS transistors except for the inverter 62 including the object for switching noise cancellation, a switch 88 becomes being an OFF state with as by failure etc., and it is Capacitor Csha. Even if the maintenance condition of the output of a comparator 60 continues for a long time, the maintenance electrical potential difference is changed to a touch-down potential side, and the current which flows to the NMOS transistor N3 connected to the outgoing end of the buffer amplifier 64 falls. Therefore, destruction of laser diode LD-A and the damage to an irradiated plane can be prevented.

[0051] Since the switch 88 consists of only NMOS transistors as notes, the size of the transistor for current outputs must be designed so that the electrical potential difference of the both ends of a switch may not turn into 1/2 or more supply voltage. Moreover, a PMOS transistor with PN-junction area which does not become more than the threshold voltage of the NMOS transistor N3 by which the convergence electrical potential difference at the time of the sample hold of the output voltage of a comparator 60 was connected to the buffer amplifier 64 may be connected to reduce DORUPU. In this case, what is necessary is just to also drive a PMOS transistor as a switch, if you want to lower ON resistance, and if that need does not exist, only the PMOS transistor which short-circuited the source drain which only has a PN junction is also connectable.

[0052] Anyway, in constituting a switch 88 from two MOS transistors, a switch 88 has a ratio with the PN-junction area of the source drain of the MOS transistor connected to the PN-junction area and the earth side of a source drain of the MOS transistor connected to a power-source side in an OFF state, and while laser diode LD-A is emitting light, it is set up so that it may change in the direction in which the amount of luminescence of laser diode LD-A decreases.

[0053] As for an input stage at least, constituting from an MOS transistor is [the buffer amplifier 64] desirable so that long duration and sample hold may be possible. With the gestalt of this operation, the operational amplifier with which the buffer amplifier 64 consisted of for example, CMOS transistors is used.

[0054] thus, as a maintenance means 90 to hold the output voltage of the comparator 60 for controlling the drive current of laser diode LD-A during a modulation period The maintenance means 90 which used the switch 88 constituted using the MOS transistor and the buffer amplifier 64 with which the input stage consisted of MOS transistors at least is used. capacitor Csha which originates in the leakage current from the PN junction of the source drain of the switch which consisted of MOS transistors of the maintenance means 90 in the maintenance period of the output voltage of the comparator 60 in a modulation period If the direction in which it is held and fluctuation of an electrical potential difference reduces the output current of current sources 80 and 82, i.e., laser diode LD-A, is emitting light the time of an automatic quantity of light control signal not entering by designing so that it may change in the direction in which the luminescence quantity of light decreases -- destruction of laser -- or optical fatigue of the photo conductor of the laser xerography produced because laser carries out a long duration exposure -- Or if it is optical recording, degradation of an optical medium can be prevented.

[0055] Furthermore, it is the above-mentioned capacitor Csha. If it makes and puts in IC capacitor Csha Can avoid the leak on the printed circuit board which mounts leak of the leakage and external capacitor of the joint of the output terminal section, and an external capacitor compared with the case where it connects outside etc., and the DORUPU property of a maintenance means (sample hold circuit) to what used conventional BAIPORA It can prevent that image quality deteriorates in the quantity of light gap by that spacing of the automatic light control of a laser diode spreads when it compares, it has improved by leaps and bounds and a laser diode array is driven, or the timing of automatic light control differing with the adjoining laser diodes.

[0056] The outgoing end of the buffer amplifier 64 is connected to the gate of the NMOS transistor N3, and the drain of the NMOS transistor N3 is grounded through resistance R6. The source of the NMOS

transistor N3 is connected to the drain of the PMOS transistor P1 which between gate drains short-circuited, and the source of the PMOS transistor P1 is connected to the power source Vcc through resistance R5. The PMOS transistor P1 constitutes current Miller circuit. Resistance R6 is formed in order that the voltage variation in the gate of the PMOS transistors P2 and P5 which constitute the current sources 80 and 82 by current leak of the sample hold capacitor Csh may ease the effect which it has on the drive current of laser LD-A. If resistance R6 is not formed, fluctuation of the gate potential of the PMOS transistors P2 and P5 will influence a drain current, i.e., the output current of current sources 80 and 82, in a square.
[0057] Capacitor Ci-A is connected to the gate of the PMOS transistors P2 and P5 which constitute current sources 80 and 82, and the current switches 76 and 78 are switched by control signal P0-A and P1-A, and also when intensity modulation of laser diode LD-A is carried out, it is made for the current value of current sources 80 and 82 to have not changed transitionally. In this case, when forming capacitor Ci-A in IC chip, since a mass thing is not obtained, the capacity of this capacitor Ci-A determines capacity for less than 256 times as a standard from 16 times of the sum total capacity between the gate drains of the PMOS transistors P2 and P5 which constitute current sources 80 and 82. For example, if it sets up 16 times, even if both current sources turn on and turn off in coincidence, the output of the buffer amplifier 64 which enables it to press down fluctuation of the gate voltage of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 to 1/16 will drive the NMOS transistor N3, and will carry out the constant current drive of the current sources 80 and 82 with the PMOS transistor P1 which constitutes current Miller circuit. In case the operational amplifier which constitutes the buffer amplifier 64 is designed, when it constitutes [therefore] an operational amplifier for the dynamic range of an input from an MOS transistor on the basis of touch-down potential in many cases, the difference input stage serves as a PMOS transistor, and it is because the dynamic range of an operational amplifier is not securable to supply voltage as a result to have reversed the current in current Miller circuit. In the case of a laser xerography, change of the injection luminous intensity of a laser diode serves as concentration of an image, and appears. However, in the edge section of the image from which reinforcement changes a lot, fluctuation of absolute concentration does not pose a big problem on vision. However, it is satisfactory if it determines that the output impedance of current Miller circuit will return to initial value with time amount extent whose gate voltage of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 from a gestalt of this operation in actuation of current Miller circuit is 1 pixel of a picture signal, since a vision top will also pose a problem if concentration changes in a large area. Namely, the gate of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 By driving with the buffer amplifier 64 which has an output impedance from which the time constant expressed as a product with the total capacity of the capacity between gate drains of the PMOS transistors P2 and P5 and addition capacity serves as an about 1-pixel modulation period in an intensity modulation period Fluctuation of the gate potential of the PMOS transistors P2 and P5 of the above-mentioned current source which cannot be controlled by capacitor Ci-A is stopped within the 1-pixel period of the intensity modulation of laser diode LD-A. Image quality degradation by the precision fall of the intensity modulation at the time of being applied to a laser xerography can be pressed down to the minimum. A dummy load 74 can make a precision fall the minimum, even if laser diode LD-A and a property are shifted somewhat.
[0058] It has contributed to the resistance R5, R1, and R2 connected between the sources of the PMOS transistors P2 and P5 and the power sources Vcc which constitute the PMOS transistor P1 and current sources 80 and 82 which constitute current Miller circuit making high the output impedance of current sources 80 and 82. Since collector current will increase exponentially to base potential if a bipolar transistor is driven by grounded emitter and the base is driven on an electrical potential difference, control usually put resistance into the emitter difficultly, and has improved the controllability.
[0059] However, at an MOS transistor, especially since a drain current changes by the square to gate potential, there is no need of putting resistance into the source. If the channel length of an MOS transistor is shortened in order to enlarge the mutual conductance gm of an MOS transistor, the output impedance of the constant current source constituted from an MOS transistor will decline. Although there are approaches, such as carrying out an MOS transistor for compensating this multistage, if supply voltage is low, the dynamic range of an output is not securable. Then, the resistance R5, R1, and R2 to which the output impedance of current sources 80 and 82 becomes large [256 times] from 16 times of the dynamic resistance at the time of modulation actuation of laser diode LD-A as mentioned already is connected between the sources of the PMOS transistors P1, P2, and P5 and the power sources Vcc which constitute a constant current source circuit. It becomes possible to secure both dynamic ranges of the output voltage for laser diode LD-A connected with the precision in the intensity modulation of 16 to 256 level by this

with sufficient balance.

[0060] In addition, the control means which inputs control signal P0-A, P1-A, APC-A, etc. (related with the drive circuit A) and which is not illustrated is equivalent to the control means of this invention.

[0061] Next, actuation of the laser diode driving gear concerning the gestalt of this operation which consists of the above-mentioned configuration is explained with reference to the timing diagram of drawing 2 . The threshold current of laser tie ODO LD-A is first set as bias power supply 84 and 86 beforehand. The same is said of the bias power supply of the drive circuit B. The drive circuit A performs automatic light control of laser diode LD-A first. If control signal APC-A becomes high-level at time of day t1 first, a switch 88 will be in an ON state, the maintenance means 90 becomes sampling mode, and the output voltage of a comparator 60 is Capacitor Csha. It will be in the condition which can be charged.

[0062] Moreover, when control signal P0-A and P1-A become high-level at time of day t1, an ON state and the PMOS transistors P4 and P7 will be [the PMOS transistors P3 and P6 which constitute the current switches 76 and 78] in an OFF state, consequently current ILD-A is supplied to laser diode LD-A from current sources 80 and 82, and laser diode LD-A emits light. The injection light of this laser diode LD-A is received by Photodiode PD, and Photodiode PD outputs the photocurrent according to the luminescence quantity of light of laser diode LD-A. This photocurrent is changed into an electrical potential difference by resistance R7, and is inputted into the inversed input terminal of a comparator 60 as a monitor electrical potential difference VPD for supervising the amount of luminescence of laser diode LD-A. The reference voltage Vr1 for setting up the desired value of the amount of luminescence in the automatic light control of laser diode LD-A is inputted into the non-inversed input terminal of a comparator 60 from a reference supply 100.

[0063] A comparator 60 compares reference voltage Vr1 with the monitor electrical potential difference VPD, and outputs the electrical potential difference according to the deflection to the buffer amplifier 64 through a switch 88. Consequently, capacitor Csha It charges with the output voltage of a comparator 60. Capacitor Csha A charge electrical potential difference is outputted to the gate of the NMOS transistor N3 from the buffer amplifier 64, the NMOS transistor N3 and the PMOS transistor P1 which constitutes current Miller circuit drive, and the constant current drive of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 with the PMOS transistor P1 is carried out.

[0064] The NMOS transistor N1 which constitutes a switch 88 will be in an OFF state, and the monitor electrical potential difference VPD is Capacitor Csha, if it goes up until it is in agreement with the reference voltage Vr1 set up by the reference supply 100, and control signal APC-A is set to a low level at time of day t2 after that. The output voltage of the comparator 60 at the time of automatic light control termination is held.

[0065] The PMOS transistors P3 and P6 which constitute the current switches 76 and 78 when control signal P0-A and P1-A are set to a low level at time of day t2 Moreover, an OFF state, The PMOS transistors P4 and P7 will be in an ON state, consequently current ILD-A supplied to laser diode LD-A from current sources 80 and 82 until now is supplied to a dummy load 74. Laser diode LD-A puts out the light, and since the light-receiving quantity of light of Photodiode PD also serves as zero, the monitor electrical potential difference VPD also becomes zero.

[0066] Next, if control signal P0-A becomes high-level at time of day t3, since the PMOS transistor P3 which constitutes the current switch 76 will be turned on, the output current (1xI) of a current source 80 is supplied to laser diode LD-A, and intensity modulation of level 1 is performed. At this time, since an OFF state and the PMOS transistor P7 of the current switch 78 are turned on by the PMOS transistor P4 of the current switch 76, and the PMOS transistor P6 of the current switch 78, the current of 2xI is supplied to a dummy load 74 from a current source 82.

[0067] Moreover, if control signal P0-A is set to a low level at time of day t4 and control signal P1-A becomes high-level, since an ON state and the PMOS transistor P7 will be turned [the PMOS transistor P3 of the current switch 76 / an OFF state and the PMOS transistor P4] off by an ON state and the PMOS transistor P6 of the current switch 78, the output current (2xI) of a current source 82 is supplied to laser diode LD-A, and intensity modulation of level 2 is performed. At this time, the current of (1xI) is supplied to a dummy load 74 from a current source 80.

[0068] Furthermore, if control signal P0-A becomes high-level from the condition of a low level at time of day t5, and it is maintained while control signal P1-A has been in a high-level condition Since an ON state and the PMOS transistor P7 are turned [an ON state and the PMOS transistor P4] off by an OFF state and the PMOS transistor P6 of the current switch 78, the PMOS transistor P3 of the current switch 76 The output current (1xI) of a current source 80 and the output current (2xI) of a current source 82 are supplied to laser diode LD-A, and intensity modulation of level 3 is performed. At this time, only a

predetermined bias current is supplied to a dummy load 74 from the PMOS transistor P9 of bias power supply 86. If both control signal P0-A and P1-A are set to a low level from high level at time of day t6 Since an OFF state and the PMOS transistor P7 are turned [an OFF state and the PMOS transistor P4] on by an ON state and the PMOS transistor P6 of the current switch 78, the PMOS transistor P3 of the current switch 76 All of the output current of current sources 80 and 82 flow to a dummy load 74, a threshold current Ith is only supplied to laser diode LD-A from bias power supply 84, and the intensity modulation of the same level 0 as the period of time of day t2-t3 is made. The monitor electrical potential difference VPD inputted into the inversed input terminal of a comparator 60 from resistance R7 according to change of current ILD-A which flows to laser diode LD-A also changes.

[0069] Henceforth [time of day t7], although intensity modulation actuation after the automatic light control of laser diode LD-B and automatic light control is performed by the drive circuit B, since the automatic light control and intensity modulation actuation which were performed by the drive circuit A at time of day t1-t6 about laser diode LD-A, and the contents are the same, explanation is omitted.

[0070] As stated above, according to the gestalt of operation of this invention, it becomes possible to also secure the dynamic range of output voltage, securing the precision at the time of intensity modulation by connecting the suitable resistance computed from the dynamic resistance at the time of actuation of a laser diode between the sources of a PMOS transistor and the power sources which constitute each of two or more current sources.

[0071] Moreover, the maintenance property of control voltage can be improved, without using an external capacitor by the high impedance nature of an MOS transistor, while being able to obtain a low noise, a high speed, and the drive circuit of low cost compared with the conventional discharge current source which it was also easy to make a discharge current source using a PMOS transistor, and the cathode was connected in common like especially a laser diode array, and combined the absorption current source and the discharge current source when a discharge current source was required, since a drive circuit and the holding circuit of control voltage are produced with a CMOS transistor.

[0072] Furthermore, fluctuation of the gate potential of the PMOS transistor which constitutes the current source produced in case a current source turns on and turns off at the time of intensity modulation can be controlled by connecting the capacitor which has a sufficiently larger capacity than the total capacity between the gate drains of the PMOS transistor which constitutes a current source between the gates of a PMOS transistor and the power sources which constitute a current source.

[0073] Moreover, the volt ampere characteristic of the laser diode linked to a current switch's laser connection and reverse side and a direct current and the impedance in the operating point omit. Fluctuation of the drain potential of the PMOS transistor which constitutes a current source by connecting an equal dummy load can be made small. And the gate of the PMOS transistor which constitutes each of two or more current sources By driving with the buffer which has an output impedance from which the time constant expressed with a product with the total capacity of the capacity between gate drains of these PMOS transistors and addition capacity serves as an about 1-pixel modulation period of a laser modulation period Image quality degradation by the precision fall of the intensity modulation at the time of stopping fluctuation of the gate potential of the PMOS transistor which constitutes the current source which it cannot finish pressing down by the capacitor for fluctuation prevention of the above-mentioned gate potential within the 1-pixel modulation period of a laser modulation, and being applied to a laser xerography It can press down to the minimum.

[0074] Furthermore, the reference potential according to individual for every laser diode required of a laser diode array One reference potential is made into the reference potential of the comparator of one drive circuit. The reference potential of the comparator of other drive circuits offset of the quantity of light control system containing the comparator to which one reference potential given previously, respectively was connected, and offset with each quantity of light control system containing the comparator of each other drive circuits, since difference is added to a previous reference potential and given If the difference of offset is set as the beginning, the output quantity of light of all the laser diodes of a laser diode array is correctly controllable by adjusting only the one above-mentioned reference potential after that.

[0075]

[Effect of the Invention] Each of two or more current sources which supply the drive current for driving a laser diode according to invention according to claim 1 as explained above Resistance is connected and constituted, respectively between the source of an MOS transistor and this MOS transistor, touch-down, or a power source. In the MOS transistor which constitutes each of two or more of said current sources, and said resistance, the ratio of transistor ratio W/L and the inverse number of the resistance of said resistance is the same. And since it was made the value to which the output resistance value of two or

more of said current sources seen from the laser diode side can drive a laser diode, and becomes sufficiently larger than the differential resistance of said laser diode at the time of modulation actuation In case intensity modulation of the drive current of a laser diode is carried out, while being able to control output fluctuation of the drive current by fluctuation of the electrical potential difference between terminals of a laser diode and being able to aim at improvement in the intensity modulation precision of a laser diode Since the voltage drop by said resistance is made to min, it becomes possible to correspond also to a laser diode with the large electrical potential difference between terminals of a laser diode.

[0076] Moreover, in case intensity modulation of the drive current which drives a laser diode using the differential mold current switch which consists of two MOS transistors in two or more current sources, respectively is carried out according to invention according to claim 2 Enough from the total capacity between the drain gates of the MOS transistor which constitutes said current source even if it drives each above-mentioned differential mold current switch The capacitor which has a large capacity is connected between the gates of an MOS transistor, the touch-down, or the power sources which constitute each of two or more current sources. and the volt ampere characteristic of the laser diode and direct current to the drain of one MOS transistor of two MOS transistors which constitute each of two current change-over-switch means and the impedance in the operating point -- abbreviation -- by connecting an equivalent load Since the voltage variation of the gate of the MOS transistor which constitutes each of two or more current sources can be controlled, improvement in the precision of intensity modulation can be aimed at.

[0077] Furthermore, since according to invention according to claim 3 the maintenance electrical potential difference of a maintenance means changes in the direction in which the amount of luminescence of a laser diode decreases within a modulation period even if the condition that luminous laser should be held by halt of a control system etc., and the output of a comparison means should be held by the maintenance means continues at the outside of a modulation period, a laser diode can -ed ** according to an overcurrent, or it can prevent that the irradiated plane of a laser diode receives damage.

[0078] It gives a comparison means of a laser diode driving gear to drive one laser diode. moreover -- according to invention according to claim 4 -- one reference voltage for the light control of any one laser diode in two or more laser diodes -- this -- To each comparison means of a laser diode driving gear to drive other remaining laser diodes, respectively The value which added the difference of the input offset voltage of a comparison means by which this reference voltage is given to said one reference voltage, and the input offset voltage of each comparison means of a laser diode driving gear to drive said each of other remaining laser diode is given as reference voltage. The rest can perform quantity of light adjustment of all laser diodes with high precision by adjusting only the one above-mentioned reference voltage.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the drive approach of a suitable laser diode driving gear to use it for the image formation equipment which forms an image in a photo conductor, and a laser diode, changing the luminescence quantity of light of a laser diode using a laser diode array.

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PRIOR ART

[Description of the Prior Art] An image output is accelerated, and the semiconductor laser component of wavelength which is different also in optical communication by forming the optical output of semiconductor laser components, such as a laser diode, into a multi-beam in a recent-years, for example, laser, xerography is made on the same chip, and the attempt which raises an optical-communication rate by multiplexing of wavelength is made.

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EFFECT OF THE INVENTION

[Effect of the Invention] Each of two or more current sources which supply the drive current for driving a laser diode according to invention according to claim 1 as explained above Resistance is connected and constituted, respectively between the source of an MOS transistor and this MOS transistor, touch-down, or a power source. In the MOS transistor which constitutes each of two or more of said current sources, and said resistance, the ratio of transistor ratio W/L and the inverse number of the resistance of said resistance is the same. And since it was made the value to which the output resistance value of two or more of said current sources seen from the laser diode side can drive a laser diode, and becomes sufficiently larger than the differential resistance of said laser diode at the time of modulation actuation In case intensity modulation of the drive current of a laser diode is carried out, while being able to control output fluctuation of the drive current by fluctuation of the electrical potential difference between terminals of a laser diode and being able to aim at improvement in the intensity modulation precision of a laser diode Since the voltage drop by said resistance is made to min, it becomes possible to correspond also to a laser diode with the large electrical potential difference between terminals of a laser diode.
[0076] Moreover, in case intensity modulation of the drive current which drives a laser diode using the differential mold current switch which consists of two MOS transistors in two or more current sources, respectively is carried out according to invention according to claim 2 Enough from the total capacity between the drain gates of the MOS transistor which constitutes said current source even if it drives each above-mentioned differential mold current switch The capacitor which has a large capacity is connected between the gates of an MOS transistor, the touch-down, or the power sources which constitute each of two or more current sources. and the volt ampere characteristic of the laser diode and direct current to the drain of one MOS transistor of two MOS transistors which constitute each of two current change-over-switch means and the impedance in the operating point -- abbreviation -- by connecting an equivalent load Since the voltage variation of the gate of the MOS transistor which constitutes each of two or more current sources can be controlled, improvement in the precision of intensity modulation can be aimed at.
[0077] Furthermore, since according to invention according to claim 3 the maintenance electrical potential difference of a maintenance means changes in the direction in which the amount of luminescence of a laser diode decreases within a modulation period even if the condition that luminous laser should be held by halt of a control system etc., and the output of a comparison means should be held by the maintenance means continues at the outside of a modulation period, a laser diode can -ed ** according to an overcurrent, or it can prevent that the irradiated plane of a laser diode receives damage.
[0078] It gives a comparison means of a laser diode driving gear to drive one laser diode. moreover -- according to invention according to claim 4 -- one reference voltage for the light control of any one laser diode in two or more laser diodes -- this -- To each comparison means of a laser diode driving gear to drive other remaining laser diodes, respectively The value which added the difference of the input offset voltage of a comparison means by which this reference voltage is given to said one reference voltage, and the input offset voltage of each comparison means of a laser diode driving gear to drive said each of other remaining laser diode is given as reference voltage. The rest can perform quantity of light adjustment of all laser diodes with high precision by adjusting only the one above-mentioned reference voltage.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, generally as for the laser diode array in which two or more laser diodes currently used for such an application were formed on the same substrate, the cathode is connected in common. This is based on that the equivalent series resistance of a laser diode is lowered for those who used the N type substrate, and a high speed drive can be performed, and the reason for being advantageous also in respect of the yield.
[0004] The current source of a discharge mold is required to drive the laser diode array to which such a cathode was connected in common on the other hand. Conventionally, MESFET of a bipolar transistor or a compound semiconductor has been used for the current source which drives a laser diode. Although a PNP transistor is needed for constituting from a bipolar transistor when it is going to make a discharge mold current source from these processes, a high-speed drive cannot be performed in the lateral mold PNP transistor usually used.
[0005] On the other hand, the vertical mold PNP transistor in which a high-speed drive is possible has a complicated manufacture process, and it is expensive. Moreover, even if the mobility of a hole is small in the case of a compound semiconductor and the P channel mold FET is made, there will be no merit using a compound semiconductor. therefore, to carry out the high-speed drive of the laser diode by the current source of a discharge mold For example, the current switch 12 in which the high-speed switching which consists of transistors Q1 and Q2, and the discharge mold current source 10 which consists of resistance R1 and R2, and which is not switched and transistors Q3 and Q4 as shown in drawing 3 R> 3 is possible is connected to a serial. It stops that make the outflow current from a current source 10 flow into a transistor Q6 side, and a laser diode LD HE current flows by turning on the transistor Q3 of the current switch 12. It is made for a current to flow from a current source 10 to a laser diode LD through diode D1 by turning off the transistor Q3 of the current switch 12 (JP,4-240787,A, JP,6-139607,A).
[0006] It can constitute from this method like so that the output capacitance of a discharge mold current source may not influence the modulation rate of the output of a laser diode by it not being necessary to switch a discharge mold current source with a slow working speed and, and connecting a discharge mold current source with a current switch through an inductance.
[0007] However, as shown to drawing 4 in this method, what carried out parallel connection of the current sources Q17 and Q18 by which series connection was carried out to two or more current switches 22 and 24 and these is connected to the discharge mold current sources 20 and 26 at a serial, and when intensity modulation of the output of a laser diode is carried out by driving alternatively two or more current switches 22 and 24 and the output of a laser diode is made low, the problem that a noise increases arises.
[0008] Namely, the source 26 of a bias current where, as for the current source shown in drawing 4 , the threshold current of a laser diode LD was set up, It is based on the suction current I of the suction mold current source 22. The output current The discharge mold current source 20 of 3xI, The suction mold current source 22 of 1xI and an absorption current use two suction mold current sources of the suction mold current source 24 of 2xI, and the suction current constitutes the current source in which the intensity modulation of 4 level of 0, 1xI, 2xI, and 3xI is possible. In drawing 4 , the threshold current is supplied to the laser diode LD by the source 26 of a bias current. In case a semiconductor laser component drives a threshold current here, it says the current which flows for a semiconductor laser component in the point which shifts to a laser oscillation condition from a spontaneous-emission condition to it. The case where it would absorb by inputting the control signals 1 and 2 which control transistors Q12 and Q14 to be in switch-on or non-switch-on, respectively, and the transistors Q12 and Q14 of the mold current sources 22 and 24 will be in non-switch-on is considered. In this case, since discharge current 3xI which flows out of the discharge mold current source 20 has the transistors Q12 and Q14 of two suction

current sources 22 and 24 in non-switch-on, it flows to a laser diode LD altogether.
[0009] Next, if it absorbs with a control signal 2 and the transistor Q14 of the mold current source 24 is made into switch-on, since the absorption mold current source 24 will drive, to a laser diode LD, the current I which absorbed from discharge current 3xI and deducted absorption current 2xI by the mold current source 24 flows. By the way, considering the shot noise generated with a transistor at this time, it will absorb with control signals 1 and 2, and the transistors Q12 and Q14 of the mold current sources 22 and 24 will be in non-switch-on, and when discharge current 3xI which flows out of the discharge mold current source 20 flows altogether to a laser diode LD, a S/N ratio becomes 3 rootI/root3 time by root (3xI).
[0010] However, absorb with a control signal 2 and the transistor Q14 of the mold current source 24 is made into switch-on. When only 1xI of the discharge current 3xI flows to a laser diode LD, The discharge mold current source 20 side a shot noise since there is no correlation in a noise at the suction mold current source 24 side -- the square of root by the side of the discharge mold current source 20 (3xI) -- ** -- it absorbs, and becomes square root root (5xI) of sum 5I with the square of root by the side of the mold current source 24 (2xI), and the S/N ratio at this time falls to rootI/root5 time. When this method performs intensity modulation so that this may show, a S/N ratio falls, so that especially level is small. image quality [in / in this / a laser xerography] -- or it becomes a problem by the laser beam communication link of a multiple value etc. There was a problem in the thing which was constituted from these reasons by the NPN transistor of a bipolar transistor, and N channel mold field-effect transistor of MESFET and which absorb and constitutes a discharge mold current source using a mold current source.
[0011] On the other hand, the laser driver by MOSFET is indicated by JP,7-335957,A and JP,8-293837,A. If it is CMOS, it is possible to make both a PMOS transistor and an NMOS transistor, and moreover, the mutual conductance gm near [in recent years] a bipolar transistor has come to be obtained by gate length's ****-ization.
[0012] The technical problem 1 and the inclination for which the drain current of an MOS transistor depends [time] on the electrical potential difference between the drain sources in a pinch-off field by gate length's ****-ization became large. If the current supplied to a laser diode changes when a constant current source is constituted and it operates it by the MOS transistor, the terminal voltage of a laser diode will change, as a result, the current value of a current source is changed, and this has a problem of the output current of a current source stopping being proportional to the input data in intensity modulation correctly.
[0013] The configuration of the laser diode driving gear which has the discharge mold current source which used PMOS for technical-problem 2 drawing 5 , and in which intensity modulation is possible is shown. In this drawing, intensity modulation becomes possible by controlling the current switches 34 and 35 on which the threshold current Ith of a laser diode LD was set by the source 30 of a bias current, and the discharge mold current source 32 (discharge current 1xI) which carried out weighting, and the discharge mold current source 33 (discharge current 2xI) were connected to the discharge mold current sources 32 and 33 by control signals P0 and P1. The gate potential of the PMOS transistor which constitutes each discharge mold current sources 32 and 33 for intensity modulation The CMOS switch 38 which constitutes a sample hold circuit 37 before starting a modulation is turned ON by making a control signal CS high-level. It is determined by carrying out negative feedback of the output of the photodiode PD which received the output light of a laser diode LD to a comparator 36, and the CMOS switch 38 is turned OFF, the value is held to Capacitor Csh, and it considers as the control voltage Vsh at the time of a modulation. Since the gate input impedance is high, direct continuation especially of the MOSFET can be carried out to the terminal of the capacitor Csh by which the control voltage at the time of a modulation is held as shown in drawing 5 .
[0014] However, conventionally, by binary Pulse Density Modulation, when having not become a problem performs intensity modulation, it becomes a problem. For example, drain electrical potential difference Vdr1 of the PMOS transistor M1 which constitutes a current source 33 if a control signal P1 is made into a low level from high level in the example of drawing 5 It goes up from touch-down potential to the terminal voltage VLD of laser. This drain electrical potential difference Vdr1 Change raises control **** Vsh through the capacity between the drain gates of the transistor M1 which constitutes a current source 33. Consequently, the output current value of current sources 32 and 33 decreases. Thus, by opening and closing a current switch for intensity modulation, control voltage Vsh changed and there was a trouble of the output current stopping corresponding correctly to modulation data.
[0015] while constituting the current source which supplies a drive current to technical-problem 3 laser diode from an MOS transistor, if the sample hold circuit which holds current source control voltage during

a modulation period is also constituted from an MOS transistor, current stability can be boiled markedly and it can improve. In the laser xerography which uses especially a laser diode array and performs high-speed writing, the merit is large. Since there is only one photodiode which receives the output light of a laser diode to two or more laser diodes, the light control before the modulation of a laser diode array has usually set up the quantity of light by time sharing. By time sharing, it divides roughly as an approach of carrying out light control, and there are two. One is the method which changes the laser diode which carries out light control for every line, and since the time amount to the next light control is long, DORUPU (voltage variation) of the current source control voltage currently held to the capacitor during the modulation period poses a problem, so that there are many laser diodes which should be carried out light control, although the time amount which the light control occupied in one line takes is not different from single laser.

[0016] It is the approach one [one more] approach carries out light control of all the laser diodes into one line each time, and since light control of all the laser diodes is carried out for every line in this case and the capacitor for sample hold of a sample hold circuit is recharged, DORUPU of a sample hold circuit does not become a problem.

[0017] However, the time amount of the light control occupied in one line must become so long that there are many laser diodes, must shorten the modulation period for writing in an image that much, and causes the fall of writing speed. Therefore, in order not to reduce the engine performance of a laser xerography, it is necessary to improve the DORUPU property of a sample hold circuit.

[0018] By the conventional single laser, moreover, only in the case of Pulse Density Modulation, since it was always fixed, as for the problem of DORUPU, quantity of light fluctuation of the scanning direction of laser did not become a big problem on vision by the application to a laser xerography for every scan. However, when a laser diode was changed for every one scan and light control of a laser diode was performed using the laser diode array put in order in the scanning direction of laser, and the direction of vertical scanning of a right angle, the timing of light control differed with the laser diodes which a laser diode array adjoins, and since slight DORUPU affected image quality, DORUPU needed to be controlled further. An MOS transistor can make easily the sample hold circuit which was extraordinarily excellent in the DORUPU property compared with the bipolar transistor.

[0019] By the way, a CMOS switch will be used, if it is usually a CMOS process as shown in a sample hold circuit at drawing 6 (a). This is for making it not dependent [the on resistance of a switch] on the terminal voltage of a switch. In drawing 6 , an NMOS switch, drawing 6 (c), and (e) show the sample hold circuit where drawing 6 (a) used the CMOS switch and, as for a switch with a CMOS noise canceller, drawing 6 (d), and (f), drawing 6 R> 6 (b) used the switch with an NMOS noise canceller, respectively. In drawing 6 , 100-105 are noise cancellers.

[0020] Generally the transistor size of the PMOS transistor of a CMOS switch and an NMOS transistor is decided in two viewpoints. By the case where a switching noise (leakage lump of the charge produced through capacity coupling from the gate) is made into min, one designs the gate width of a PMOS transistor and an NMOS transistor equally. Since the feed through from the gate of a PMOS transistor and an NMOS transistor is reversed polarity when it carries out like this, the switching noise produced to a PMOS transistor and an NMOS transistor offsets each other. however, a switching noise is strictly offset by this method -- the breadth of the inversion layer under the gate -- a PMOS transistor and an NMOS transistor -- it is -- etc. -- about [of the becoming supply voltage to spread] -- it is only at one half of the times, and on other electrical potential differences, since the feed through by the inversion layer of CMOS switch both ends differs with a PMOS transistor and an NMOS transistor, each other is not offset. For this reason, in order to connect to the terminal by the side of Capacitor Csh the MOS transistor of the dummy which made gate width of an MOS transistor one half or to raise the effectiveness of noise cancellation further not to be based on supply voltage but reduce a switching noise, connecting the MOS transistor of the dummy which made gate width one half also between comparator outputs is also performed.

[0021] Another viewpoint sets to W gate width of the gate of the PMOS transistor which constitutes a CMOS switch from a case where the supply voltage dependency of on resistance is made small, and an NMOS transistor, sets gate length to L, and designs the ratio (transistor ratio) of W/L by the inverse number ratio of the mobility of a hole and an electron. If it carries out like this, the value of the on resistance of a PMOS transistor when the potential of the both ends of a CMOS switch is in agreement with supply voltage, and the on resistance of an NMOS transistor when the potential of CMOS switch both ends is in agreement with touch-down potential will become equal. With a CMOS switch, since a low switching noise is required as usually low on resistance, the PMOS transistor and NMOS transistor which

constitute a CMOS switch are min, and equal channel length designs them. For this reason, even if it designs in which viewpoint, the width of face of a PMOS transistor and an NMOS transistor is equal, or the gate width of a PMOS transistor becomes large. Consequently, with a PMOS transistor and an NMOS transistor, omit, and supposing the PN-junction leak per unit area is equal Since N substrate is connected to the power source with the PMOS transistor when it is left, while the sample hold circuit has been a HOLD status, Since leakage current flows into the capacitor Csh for sample hold through the PN junction of this N substrate and P layers which are source drains and P substrate is grounded with the NMOS transistor, Leakage current flows out of the capacitor Csh for sample hold through the PN junction of this P substrate and N layer which is a source drain. Consequently, the output of a sample hold circuit is converged on the electrical potential difference of I/2 or more supply voltage, as the leak from the PN junction of the source drain of an NMOS transistor and a PMOS transistor shows to drawing 7 . When the NMOS transistor of a CMOS switch was driven on this electrical potential difference, there was a problem that an excessive current flowed to a laser diode and destroyed a laser diode.

[0022] In the automatic light control of a technical-problem 4 laser-diode array, as already stated, light control is carried out by time sharing to two or more laser diodes using one photodiode. Therefore, the automatic light control of each laser diode should just compare with one reference voltage corresponding to the desired value of the amount of luminescence of a laser diode one photodiode output which detects the optical output of a laser diode by the comparator as an error detection means. However, since offset differed separately, two or more comparators used in fact for automatic light control needed to be doubled with each comparator, and whenever the reference voltage of each comparator changed reference voltage, they needed to adjust it for every laser diode.

[0023] This invention is made in view of such a situation, and it sets it as the 1st purpose to offer the laser diode driving gear which aimed at improvement in intensity modulation precision.

[0024] Moreover, it sets it as the 2nd purpose to offer the laser diode driving gear which can prevent that the laser diode under luminescence damages this invention according to an overcurrent even if a maintenance means (sample hold circuit) to hold the control voltage which controls the drive current of a laser diode by malfunctions, such as a halt of a control system, continues the maintenance condition of control voltage.

[0025] Furthermore, this invention sets it as the 3rd purpose to offer the drive approach of the laser diode which can control the quantity of light of two or more laser diodes of all only by adjusting one reference voltage for setting the luminescence quantity of light of a laser diode as desired value with high precision.

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MEANS

[Means for Solving the Problem] In order to attain the 1st purpose invention according to claim 1 After carrying out automatic light control of the laser diode so that the amount of luminescence of a laser diode may become a value corresponding to reference voltage based on the comparison result of a comparison means to measure the reference voltage for the light control of a laser diode, and the detection output of the amount of luminescence of a laser diode, In the laser diode driving gear which modulates a laser beam based on a picture signal While consisting of resistance with which it connected between a maintenance means to hold the output of the comparison means at the time of said automatic light control termination, and the source of an MOS transistor and this MOS transistor, with which common connection of the gate which undergoes the output of this maintenance means respectively was made, touch-down or a power source Two or more current sources which supply the drive current for driving a laser diode, Two or more 1st switching means established between each of two or more of these current sources, and a laser diode, The control means which modulates the drive current supplied to said laser diode by operating alternatively said two or more 1st switching means based on said picture signal, In the MOS transistor which **** and constitutes each of two or more of said current sources, and said resistance The ratio of transistor ratio W/L which is the ratio of gate width W of an MOS transistor and gate length L, and the inverse number of the resistance of said resistance is the same. And it is characterized by making it the value to which the output resistance value of two or more of said current sources seen from the laser diode side can drive a laser diode, and becomes sufficiently larger than the differential resistance of said laser diode at the time of modulation actuation.

[0027] Each of two or more current sources which supply the drive current for driving a laser diode in the laser diode driving gear of the above-mentioned configuration Resistance is connected and constituted, respectively between the source of an MOS transistor and this MOS transistor, touch-down, or a power source. In the MOS transistor which constitutes each of two or more of said current sources, and said resistance, the ratio of transistor ratio W/L and the inverse number of the resistance of said resistance is the same. And since it was made the value to which the output resistance value of two or more of said current sources seen from the laser diode side can drive a laser diode, and becomes sufficiently larger than the differential resistance of said laser diode at the time of modulation actuation In case intensity modulation of the drive current of a laser diode is carried out, while being able to control output fluctuation of the drive current by fluctuation of the electrical potential difference between terminals of a laser diode and being able to aim at improvement in the intensity modulation precision of a laser diode It becomes possible to correspond also to a laser diode with the large electrical potential difference between terminals of a laser diode. What is necessary is just to adjust this resistance so that the output resistance value of a current source may become 16 or more times of this at least when performing intensity modulation (the gradation for several ohms - 10 ohms of numbers (for example, 16 gradation) of the dynamic resistance of the laser diode near a threshold current) in the case of several 10mW infrared laser actually marketed.

[0028] Moreover, invention according to claim 2 is set to a laser diode driving gear according to claim 1. Between the gates of an MOS transistor, the touch-down, or the power sources which constitute each of two or more of said current sources The 2nd switching means by which the capacitor which has a capacity smaller than 256 times with the total larger capacity of the capacity between the drain gates of each of said MOS transistor than 16 times is connected, and said maintenance means is connected to the outgoing end of said comparison means in an end, It has the output resistance from which the time constant expressed with a product with the total capacity of the capacity between the drain gates of each of said MOS transistor and the capacity of said capacitor serves as a period which is 1 pixel of a picture signal about. The buffer amplifier with which the input edge was connected to the other end of said 2nd switching

means, and the input stage consisted of MOS transistors, It constitutes from a capacitor holding the output of said comparison means by which an end is connected to the input edge of this buffer amplifier, and the other end is grounded. It is the differential mold current switch which consists of two MOS transistors to which common connection of the source is made, it is connected to each output side of two or more of said current sources, and the gate drives each of two or more of said 1st switching means by the complementary signal. One drain of two MOS transistors is connected to said laser diode. this -- It is characterized by for the volt ampere characteristic of a direct current and the impedance of said abbreviation [laser diode, abbreviation, etc.] in the operating point having been in the drain of another side by carrying out, and connecting a load so that both the drain electrical potential difference at the time of turning on complementary may become equal.

[0029] In the laser diode driving gear of the above-mentioned configuration, two or more current sources, respectively It connects with a laser diode through the 1st switching means which is the differential mold current switch which consists of two MOS transistors. In case intensity modulation of the drive current which drives a laser diode by operating the 1st switching means of the above alternatively is carried out Enough from the total capacity of the capacity between the drain gates of the MOS transistor which constitutes said current source even if it changes the level of the modulating signal which is a complementary signal which drives each 1st switching means of the above The capacitor which has a large capacity is connected between the gates of an MOS transistor, the touch-down, or the power sources which constitute each of two or more current sources. and the volt ampere characteristic of the laser diode and direct current to the drain of one MOS transistor of two MOS transistors which constitute each of the 1st two switching means and the impedance in the operating point -- abbreviation -- by connecting an equivalent load Since the voltage variation of the gate of the MOS transistor which constitutes each of two or more current sources can be controlled, improvement in the precision of intensity modulation can be aimed at.

[0030] In order to attain the 2nd purpose invention according to claim 3 In a laser diode driving gear according to claim 2, the 2nd switching means which constitutes said maintenance means consists of MOS transistors. In the PN junction of the source drain of the MOS transistor which constitutes said 2nd switching means The PN-junction area of the substrate of the P-channel MOS transistor connected to a power-source side, and the source drain of this transistor, Said 2nd switching means has a ratio with the PN-junction area of the substrate of the N-channel MOS transistor connected to the earth side, and the source drain of this transistor in an OFF state. While said laser diode is emitting light, it is characterized by being set up so that it may change in the direction in which the amount of luminescence of this laser diode decreases with time amount. As a configuration of the MOS transistor of the 2nd switching means, there are drawing 6 (a) thru/or (f), and it can be used, even if it constitutes so that the NMOS transistor in this drawing (b), (d), and (f) may be further permuted by the PMOS transistor. In addition, it is also possible to float from a power source and touch-down, to make the substrate of a PMOS transistor or an NMOS transistor into another potential, and to operate it respectively.

[0031] Since the maintenance electrical potential difference of a maintenance means changes in the direction in which the amount of luminescence of a laser diode decreases with the passage of time within a modulation period even if the condition that luminous laser should be held by halt of a control system etc. in the laser-diode driving gear of the above-mentioned configuration, and the output of a comparison means should be held by the maintenance means continues at the outside of a modulation period, a laser diode can -ed ** according to an overcurrent, or it can prevent that the irradiated plane of a laser diode wins popularity in damage.

[0032] In order to attain the 3rd purpose invention according to claim 4 It is constituted so that a single photodetection means to detect the amount of luminescence of a laser diode may be shared with two or more laser diode driving gears. And so that the amount of luminescence of two or more laser diodes may become a value corresponding to reference voltage based on the comparison result of a comparison means to measure the reference voltage for the light control of a laser diode, and the detection output of said photodetection means In the drive approach of the laser diode which carries out light control of two or more laser diodes by time sharing It gives a comparison means of a laser diode driving gear to drive one laser diode. the reference voltage for the light control of any one laser diode in said two or more laser diodes -- this -- To each comparison means of a laser diode driving gear to drive other remaining laser diodes, respectively The value which added the difference with the offset voltage which each quantity of light control system including each comparison means of a laser diode driving gear to drive the offset voltage which a quantity of light control system including a comparison means by which this reference voltage is given to said reference voltage has, and said each of other remaining laser diode has is made into

reference voltage. It is characterized by giving.

[0033] By the drive approach of the laser diode of the above-mentioned configuration It gives a comparison means of a laser diode driving gear to drive one laser diode. one reference voltage for the light control of any one laser diode in two or more laser diodes -- this -- To each comparison means of a laser diode driving gear to drive other remaining laser diodes, respectively The value which added the difference with the offset voltage which each quantity of light control system including each comparison means of a laser diode driving gear to drive the offset voltage which a quantity of light control system including a comparison means by which this reference voltage is given to said one reference voltage has, and said each of other remaining laser diode has is made into reference voltage. It can give and the rest can perform quantity of light adjustment of all laser diodes with high precision by adjusting only the one above-mentioned reference voltage.

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EXAMPLE

[Example] The gestalt of operation of this invention is explained with reference to a drawing. The configuration of the laser diode driving gear concerning the gestalt of operation of this invention is shown in drawing 1 . The laser diode driving gear concerning the gestalt of this operation forms only one photo detector PD as a photodetection means to detect laser diode LD-A and the output light of LD-B to two laser diode LD-A and LD-B, and to output a photocurrent, and it is constituted so that automatic light control of laser diode LD-A and LD-B may be carried out by the drive circuit A and the drive circuit B and intensity modulation may be carried out by time sharing. Since the configuration of two drive circuits A and B is the same, the drive circuit A is explained here. In drawing 1 R> 1, common connection of the cathode of laser diode LD-A and LD-B is made, and it is grounded. The current sources 80 and 82 with weight are connected through the current switches 76 and 78 corresponding to the 1st switching means of this invention in the anode of laser diode LD-A. From the resistance R1 to which the current source 80 was connected between the source of the PMOS transistor P2 and the PMOS transistor P2, and a power source Vcc, the current source 82 consists of resistance R2 connected between the source of the PMOS transistor P5 and the PMOS transistor P5, and a power source Vcc, respectively. Weighting of the output current ratio of current sources 80 and 82 is carried out to 1:2, and transistor ratio W/L (W is gate width and L is gate length.) of the PMOS transistors P2 and P5 is set up so that the output current of a current source 80 may be set to 1xI and the output current of a current source 82 may be set to 2xI on the basis of the output current of a current source 80.
[0035] Moreover, the resistance of the resistance R1 and R2 which forms the output resistance of current sources 80 and 82 The ratio of the inverse number and transistor ratio W/L of the PMOS transistors P2 and P5 is equal respectively. The resistance of the output resistance of the current sources 80 and 82 seen from the laser diode LD-A side can drive laser diode LD-A. And enough from the differential resistance of laser diode LD-A at the time of after [a modulation] actuation When performing intensity modulation of the value which becomes large, for example, 16 gradation, one 256 times [16 to] the value of said differential resistance of this is chosen. It is because the margin of supply voltage is only lost by the voltage drop in resistance R1 and R2 even if it is about 40dB which made the upper limit into 256 times here and the S/N ratio of a laser diode increases it more than this with an electric-eye output by various noise sources.
[0036] The current switch 76 consists of two PMOS transistors P3 and P4 and inverters 66 and 68 by which the source is connected to the drain of the PMOS transistor P2 which common connection is made and constitutes a current source 80.
[0037] Moreover, the current switch 78 consists of two PMOS transistors P6 and P7 and inverters 70 and 72 by which the source is connected to the drain of the PMOS transistor P5 which common connection is made and constitutes a current source 82. The current switch 76 and the current switch 78 are differential mold current switches which the gate of the PMOS transistors P3 and P4 or the PMOS transistor P6, and P7** drives by the complementary signal, respectively.
[0038] The drain of the PMOS transistors P3 and P6 of the current switches 76 and 78 is connected to the anode of laser diode LD-A, and the drain of the PMOS transistors P4 and P7 of the current switches 76 and 78 is connected to the end of a dummy load 74, respectively. The other end of a dummy load 74 is grounded.
[0039] Through the inverter 66, through inverters 66 and 68, it is constituted by the gate of the PMOS transistor P3 of the current switch 76 at the gate of the PMOS transistor P4, respectively so that control signal P0-A may be inputted. Moreover, through the inverter 70, through inverters 70 and 72, it is constituted by the gate of the PMOS transistor P6 of the current switch 78 at the gate of the PMOS

transistor P7, respectively so that control signal P1-A may be inputted. Switching control of the current switches 76 and 78 is carried out by control signal P0-A and P1-A, and they carry out intensity modulation of laser diode LD-A. It prevents that the control voltage which controls the drive current of laser diode LD-A which capacitor Ci-A holds in case a switch turns off by driving complementary with inverters 68 and 72 shifts transitionally the gate of each PMOS transistors P3, P4, P6, and P7 which constitute the current switches 76 and 78 by the feed through of a switch control signal.
[0040] It is possible it to increase intensity modulation level by increasing a current source with weight further with the gestalt of this operation, including level zero, although modulation level is the intensity modulation of 4 level. Moreover, since a drive circuit is produced by the CMOS process in the laser diode driving gear concerning the gestalt of this operation It is easy to make current sources 80 and 82 and the discharge mold current source which constituted the current switches 76 and 78 using a PMOS transistor. It compares with the conventional discharge mold current source which the cathode was connected in common like especially a laser diode array, and combined the absorption mold current source and the discharge mold current source when a discharge mold current source was required. At a low noise and a high speed And the drive circuit, as a result laser diode driving gear of low cost can be obtained.
[0041] Furthermore, the source 84 of a bias current which consists of the source 76 of good transformation, a PMOS transistor P8, and resistance R3 is connected to the anode of laser diode LD-A, and it is constituted so that a threshold current Ith may always be supplied to laser diode LD-A by the source 84 of a bias current.
[0042] Moreover, the source 86 of a bias current which consists of the source 76 of good transformation, a PMOS transistor P9, and resistance R4 is connected to the end of a dummy load 74, and it is constituted so that a bias current may always be supplied also to a dummy load 74 by the source 86 of a bias current. The source 86 of a bias current is to change the terminal voltage of a dummy load 74 similarly, and for fluctuation of potential Vdr0-A in the output node of current sources 80 and 82 and Vdr1-A make it min in all intensity modulation fields, when intensity modulation is carried out and the terminal voltage of laser diode LD-A changes. Therefore, omitting with the precision prescribe of intensity modulation is also possible.
[0043] When a dummy load 74 turns on the current switches 76 and 78 and turns off, the volt ampere characteristic of a direct current and the impedance in the operating point are constituted using diode, resistance, a capacitor, and an inductance as laser diode LD-A, abbreviation, and a load that becomes equal so that fluctuation may become [potential Vdr0-A in the output node of current sources 80 and 82, and Vdr1-A] small also transitionally also in direct current. Therefore, when the current switches 76 and 78 are switched on and turned off, fluctuation of potential Vdr0-A in the output node of current sources 80 and 82 and Vdr1-A is controlled.
[0044] PD is a photodiode which functions as a photodetection means to detect the amount of luminescence of laser diode LD-A, for example, it is mounted in a package with two or more laser diodes, and the PIN photodiode which receives the light from the tooth back of a laser diode is used. Photodiode PD is grounded through the resistance R7 as a current potential conversion means whose anode changes into an electrical potential difference the photocurrent outputted by Photodiode PD, and the cathode is connected to the power source Vcc.
[0045] 60 is a comparator corresponding to the comparison means of this invention which compares the electrical potential difference according to the luminescence quantity of light of laser diode LD-A in which current potential conversion was carried out by resistance R7 with the reference voltage Vr1 set up by the reference supply 100 which generates the reference voltage which is the desired value of the luminescence quantity of light of laser diode LD-A, and outputs the electrical potential difference according to the deflection. This comparator is constituted by the operational amplifier. Reference voltage Vr1 is set up by the reference supply 100, measuring the luminescence quantity of light of laser diode LD-A with an actinometer at the time of the automatic light control of laser diode LD-A. However, it becomes the value which the offset voltage of the quantity of light control system which contains a comparator 60 in the electrical potential difference which produces the reference voltage actually set up since an electrical potential difference is changed by the leakage lump from the gate signal of the NMOS transistors N1 and N2 in case the comparator consists of operational amplifiers strictly, a comparator input has offset and it turns off with a switch 62 further to the both ends of resistance R6 with the photocurrent output of Photodiode PD joined. Although it is better for especially the input offset voltage of a comparator to prepare reference voltage separately in order to raise the precision of the light control of a laser diode, since it varies for every comparator, it is complicated. So, offset uses not being influenced greatly for the drive conditions of a laser diode, and to one reference voltage Vr1, it consists of gestalten of this operation

so that the difference of the input offset voltage of a comparator 60,160 may be added and the reference voltage Vr2 supplied to the comparator 160 of another drive circuit B may be impressed. Namely, as for reference voltage Vr2, only the difference of the input offset voltage of a comparator 60,160 is set up. Both laser diode LD-A and the luminescence quantity of light of LD-B can be set up with a sufficient precision in a high precision only by adjusting the reference voltage (the gestalt of this operation reference voltage Vr1 of a comparator 60) which is one side by this. Although the number of laser diode drive drive circuits (laser diode driving gear) is two with the gestalt of this operation, it is the same when this carries out light control of the n laser diodes by time sharing by n laser diode drive circuits. that is So that the photodiode PD which is a single photodetection means to detect the luminescence quantity of light of a laser diode may be shared with other laser diode driving gears With two or more laser diode driving gears l, --, n (n>=2) which have a comparator as an error detection means to measure the reference voltage for the light control of the constituted laser diode, and the detection output of said photodetection means [two or more laser diodes 1, --, when carrying out light control of the n (n>=2) by time sharing] The reference voltage 1 for the light control of a laser diode 1 is given to the comparison means (comparator) of the laser diode driving gear 1. What is necessary is just to give the value which added the difference of the input offset voltage of the comparison means of the laser diode driving gear 1, and the input offset voltage of the comparison means of the laser diode driving gear n to reference voltage 1 as reference voltage n to the laser diode driving gear n.

[0046] The outgoing end of a comparator 60 minds the switch 88 corresponding to the 2nd switching means of this invention, and is the input edge and Capacitor Csha of the buffer amplifier 64. It connects with the end and is Capacitor Csha. The other end is grounded.

[0047] A switch 88, the buffer amplifier 64, and capacitor Csha A maintenance means 90 to hold the control voltage for controlling the drive current of laser diode LD-A which is the output voltage of the comparator 60 at the time of automatic light control termination is constituted. The maintenance means 90 is equivalent to the maintenance means of this invention.

[0048] The switch 88 has the NMOS transistor N1, the NMOS transistor N2 for noise cancellation which between source drains connected too hastily and was connected between the NMOS transistor N1 and the input edge of the buffer amplifier 64, and the inverter 62. The source of the NMOS transistor N1 is connected to the outgoing end of a comparator 60, and the drain is connected to the source of the NMOS transistor N2. The drain of the NMOS transistor N2 is connected to the input edge of the buffer amplifier 64. The NMOS transistor N1 and channel length are equal, and gate width is designed by the NMOS transistor N2 so that it may become half.

[0049] Moreover, control signal APC-A which controls switching of a switch 88, respectively is directly inputted into the gate of the NMOS transistor N2 through an inverter 62 at the gate of the NMOS transistor N1. In addition, as for the control signal to the gate of the NMOS transistors N1 and N2, it is desirable to consider as the complementary signal which started within limits which do not influence actuation and made falling late in order to control a switching noise as much as possible.

[0050] Moreover, since the switch 88 consists of only NMOS transistors except for the inverter 62 including the object for switching noise cancellation, a switch 88 becomes being an OFF state with as by failure etc., and it is Capacitor Csha. Even if the maintenance condition of the output of a comparator 60 continues for a long time, the maintenance electrical potential difference is changed to a touch-down potential side, and the current which flows to the NMOS transistor N3 connected to the outgoing end of the buffer amplifier 64 falls. Therefore, destruction of laser diode LD-A and the damage to an irradiated plane can be prevented.

[0051] Since the switch 88 consists of only NMOS transistors as notes, the size of the transistor for current outputs must be designed so that the electrical potential difference of the both ends of a switch may not turn into 1/2 or more supply voltage. Moreover, a PMOS transistor with PN-junction area which does not become more than the threshold voltage of the NMOS transistor N3 by which the convergence electrical potential difference at the time of the sample hold of the output voltage of a comparator 60 was connected to the buffer amplifier 64 may be connected to reduce DORUPU. In this case, what is necessary is just to also drive a PMOS transistor as a switch, if you want to lower ON resistance, and if that need does not exist, only the PMOS transistor which short-circuited the source drain which only has a PN junction is also connectable.

[0052] Anyway, in constituting a switch 88 from two MOS transistors, a switch 88 has a ratio with the PN-junction area of the source drain of the MOS transistor connected to the PN-junction area and the earth side of a source drain of the MOS transistor connected to a power-source side in an OFF state, and while laser diode LD-A is emitting light, it is set up so that it may change in the direction in which the amount of

luminescence of laser diode LD-A decreases.
[0053] As for an input stage at least, constituting from an MOS transistor is [the buffer amplifier 64] desirable so that long duration and sample hold may be possible. With the gestalt of this operation, the operational amplifier with which the buffer amplifier 64 consisted of for example, CMOS transistors is used.

[0054] thus, as a maintenance means 90 to hold the output voltage of the comparator 60 for controlling the drive current of laser diode LD-A during a modulation period The maintenance means 90 which used the switch 88 constituted using the MOS transistor and the buffer amplifier 64 with which the input stage consisted of MOS transistors at least is used. capacitor Csha which originates in the leakage current from the PN junction of the source drain of the switch which consisted of MOS transistors of the maintenance means 90 in the maintenance period of the output voltage of the comparator 60 in a modulation period If the direction in which it is held and fluctuation of an electrical potential difference reduces the output current of current sources 80 and 82, i.e., laser diode LD-A, is emitting light the time of an automatic quantity of light control signal not entering by designing so that it may change in the direction in which the luminescence quantity of light decreases -- destruction of laser -- or optical fatigue of the photo conductor of the laser xerography produced because laser carries out a long duration exposure -- Or if it is optical recording, degradation of an optical medium can be prevented.
[0055] Furthermore, it is the above-mentioned capacitor Csha. If it makes and puts in IC capacitor Csha Can avoid the leak on the printed circuit board which mounts leak of the leakage and external capacitor of the joint of the output terminal section, and an external capacitor compared with the case where it connects outside etc., and the DORUPU property of a maintenance means (sample hold circuit) to what used conventional BAIPORA It can prevent that image quality deteriorates in the quantity of light gap by that spacing of the automatic light control of a laser diode spreads when it compares, it has improved by leaps and bounds and a laser diode array is driven, or the timing of automatic light control differing with the adjoining laser diodes.
[0056] The outgoing end of the buffer amplifier 64 is connected to the gate of the NMOS transistor N3, and the drain of the NMOS transistor N3 is grounded through resistance R6. The source of the NMOS transistor N3 is connected to the drain of the PMOS transistor P1 which between gate drains short-circuited, and the source of the PMOS transistor P1 is connected to the power source Vcc through resistance R5. The PMOS transistor P1 constitutes current Miller circuit. Resistance R6 is formed in order that the voltage variation in the gate of the PMOS transistors P2 and P5 which constitute the current sources 80 and 82 by current leak of the sample hold capacitor Csh may ease the effect which it has on the drive current of laser LD-A. If resistance R6 is not formed, fluctuation of the gate potential of the PMOS transistors P2 and P5 will influence a drain current, i.e., the output current of current sources 80 and 82, in a square.
[0057] Capacitor Ci-A is connected to the gate of the PMOS transistors P2 and P5 which constitute current sources 80 and 82, and the current switches 76 and 78 are switched by control signal P0-A and P1-A, and also when intensity modulation of laser diode LD-A is carried out, it is made for the current value of current sources 80 and 82 to have not changed transitionally. In this case, when forming capacitor Ci-A in IC chip, since a mass thing is not obtained, the capacity of this capacitor Ci-A determines capacity for less than 256 times as a standard from 16 times of the sum total capacity between the gate drains of the PMOS transistors P2 and P5 which constitute current sources 80 and 82. For example, if it sets up 16 times, even if both current sources turn on and turn off in coincidence, the output of the buffer amplifier 64 which enables it to press down fluctuation of the gate voltage of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 to 1/16 will drive the NMOS transistor N3, and will carry out the constant current drive of the current sources 80 and 82 with the PMOS transistor P1 which constitutes current Miller circuit. In case the operational amplifier which constitutes the buffer amplifier 64 is designed, when it constitutes [therefore] an operational amplifier for the dynamic range of an input from an MOS transistor on the basis of touch-down potential in many cases, the difference input stage serves as a PMOS transistor, and it is because the dynamic range of an operational amplifier is not securable to supply voltage as a result to have reversed the current in current Miller circuit. In the case of a laser xerography, change of the injection luminous intensity of a laser diode serves as concentration of an image, and appears. However, in the edge section of the image from which reinforcement changes a lot, fluctuation of absolute concentration does not pose a big problem on vision. However, it is satisfactory if it determines that the output impedance of current Miller circuit will return to initial value with time amount extent whose gate voltage of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 from a gestalt of this operation in actuation of current Miller circuit is 1 pixel of a picture signal, since a vision top

will also pose a problem if concentration changes in a large area. Namely, the gate of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 By driving with the buffer amplifier 64 which has an output impedance from which the time constant expressed as a product with the total capacity of the capacity between gate drains of the PMOS transistors P2 and P5 and addition capacity serves as an about 1-pixel modulation period in an intensity modulation period Fluctuation of the gate potential of the PMOS transistors P2 and P5 of the above-mentioned current source which cannot be controlled by capacitor Ci-A is stopped within the 1-pixel period of the intensity modulation of laser diode LD-A. Image quality degradation by the precision fall of the intensity modulation at the time of being applied to a laser xerography can be pressed down to the minimum. A dummy load 74 can make a precision fall the minimum, even if laser diode LD-A and a property are shifted somewhat.
[0058] It has contributed to the resistance R5, R1, and R2 connected between the sources of the PMOS transistors P2 and P5 and the power sources Vcc which constitute the PMOS transistor P1 and current sources 80 and 82 which constitute current Miller circuit making high the output impedance of current sources 80 and 82. Since collector current will increase exponentially to base potential if a bipolar transistor is driven by grounded emitter and the base is driven on an electrical potential difference, control usually put resistance into the emitter difficultly, and has improved the controllability.
[0059] However, at an MOS transistor, especially since a drain current changes by the square to gate potential, there is no need of putting resistance into the source. If the channel length of an MOS transistor is shortened in order to enlarge the mutual conductance gm of an MOS transistor, the output impedance of the constant current source constituted from an MOS transistor will decline. Although there are approaches, such as carrying out an MOS transistor for compensating this multistage, if supply voltage is low, the dynamic range of an output is not securable. Then, the resistance R5, R1, and R2 to which the output impedance of current sources 80 and 82 becomes large [256 times] from 16 times of the dynamic resistance at the time of modulation actuation of laser diode LD-A as mentioned already is connected between the sources of the PMOS transistors P1, P2, and P5 and the power sources Vcc which constitute a constant current source circuit. It becomes possible to secure both dynamic ranges of the output voltage for laser diode LD-A connected with the precision in the intensity modulation of 16 to 256 level by this with sufficient balance.
[0060] In addition, the control means which inputs control signal P0-A, P1-A, APC-A, etc. (related with the drive circuit A) and which is not illustrated is equivalent to the control means of this invention.
[0061] Next, actuation of the laser diode driving gear concerning the gestalt of this operation which consists of the above-mentioned configuration is explained with reference to the timing diagram of drawing 2 . The threshold current of laser tie ODO LD-A is first set as bias power supply 84 and 86 beforehand. The same is said of the bias power supply of the drive circuit B. The drive circuit A performs automatic light control of laser diode LD-A first. If control signal APC-A becomes high-level at time of day t1 first, a switch 88 will be in an ON state, the maintenance means 90 becomes sampling mode, and the output voltage of a comparator 60 is Capacitor Csha. It will be in the condition which can be charged.
[0062] Moreover, when control signal P0-A and P1-A become high-level at time of day t1, an ON state and the PMOS transistors P4 and P7 will be [the PMOS transistors P3 and P6 which constitute the current switches 76 and 78] in an OFF state, consequently current ILD-A is supplied to laser diode LD-A from current sources 80 and 82, and laser diode LD-A emits light. The injection light of this laser diode LD-A is received by Photodiode PD, and Photodiode PD outputs the photocurrent according to the luminescence quantity of light of laser diode LD-A. This photocurrent is changed into an electrical potential difference by resistance R7, and is inputted into the inversed input terminal of a comparator 60 as a monitor electrical potential difference VPD for supervising the amount of luminescence of laser diode LD-A. The reference voltage Vr1 for setting up the desired value of the amount of luminescence in the automatic light control of laser diode LD-A is inputted into the non-inversed input terminal of a comparator 60 from a reference supply 100.
[0063] A comparator 60 compares reference voltage Vr1 with the monitor electrical potential difference VPD, and outputs the electrical potential difference according to the deflection to the buffer amplifier 64 through a switch 88. Consequently, capacitor Csha It charges with the output voltage of a comparator 60. Capacitor Csha A charge electrical potential difference is outputted to the gate of the NMOS transistor N3 from the buffer amplifier 64, the NMOS transistor N3 and the PMOS transistor P1 which constitutes current Miller circuit drive, and the constant current drive of the PMOS transistors P2 and P5 which constitute current sources 80 and 82 with the PMOS transistor P1 is carried out.
[0064] The NMOS transistor N1 which constitutes a switch 88 will be in an OFF state, and the monitor electrical potential difference VPD is Capacitor Csha, if it goes up until it is in agreement with the

reference voltage Vr1 set up by the reference supply 100, and control signal APC-A is set to a low level at time of day t2 after that. The output voltage of the comparator 60 at the time of automatic light control termination is held.

[0065] The PMOS transistors P3 and P6 which constitute the current switches 76 and 78 when control signal P0-A and P1-A are set to a low level at time of day t2 Moreover, an OFF state, The PMOS transistors P4 and P7 will be in an ON state, consequently current ILD-A supplied to laser diode LD-A from current sources 80 and 82 until now is supplied to a dummy load 74. Laser diode LD-A puts out the light, and since the light-receiving quantity of light of Photodiode PD also serves as zero, the monitor electrical potential difference VPD also becomes zero.

[0066] Next, if control signal P0-A becomes high-level at time of day t3, since the PMOS transistor P3 which constitutes the current switch 76 will be turned on, the output current (1xI) of a current source 80 is supplied to laser diode LD-A, and intensity modulation of level 1 is performed. At this time, since an OFF state and the PMOS transistor P7 of the current switch 78 are turned on by the PMOS transistor P4 of the current switch 76, and the PMOS transistor P6 of the current switch 78, the current of 2xI is supplied to a dummy load 74 from a current source 82.

[0067] Moreover, if control signal P0-A is set to a low level at time of day t4 and control signal P1-A becomes high-level, since an ON state and the PMOS transistor P7 will be turned [the PMOS transistor P3 of the current switch 76 / an OFF state and the PMOS transistor P4] off by an ON state and the PMOS transistor P6 of the current switch 78, the output current (2xI) of a current source 82 is supplied to laser diode LD-A, and intensity modulation of level 2 is performed. At this time, the current of (1xI) is supplied to a dummy load 74 from a current source 80.

[0068] Furthermore, if control signal P0-A becomes high-level from the condition of a low level at time of day t5, and it is maintained while control signal P1-A has been in a high-level condition Since an ON state and the PMOS transistor P7 are turned [an ON state and the PMOS transistor P4] off by an OFF state and the PMOS transistor P6 of the current switch 78, the PMOS transistor P3 of the current switch 76 The output current (1xI) of a current source 80 and the output current (2xI) of a current source 82 are supplied to laser diode LD-A, and intensity modulation of level 3 is performed. At this time, only a predetermined bias current is supplied to a dummy load 74 from the PMOS transistor P9 of bias power supply 86. If both control signal P0-A and P1-A are set to a low level from high level at time of day t6 Since an OFF state and the PMOS transistor P7 are turned [an OFF state and the PMOS transistor P4] on by an ON state and the PMOS transistor P6 of the current switch 78, the PMOS transistor P3 of the current switch 76 All of the output current of current sources 80 and 82 flow to a dummy load 74, a threshold current Ith is only supplied to laser diode LD-A from bias power supply 84, and the intensity modulation of the same level 0 as the period of time of day t2-t3 is made. The monitor electrical potential difference VPD inputted into the inversed input terminal of a comparator 60 from resistance R7 according to change of current ILD-A which flows to laser diode LD-A also changes.

[0069] Henceforth [time of day t7], although intensity modulation actuation after the automatic light control of laser diode LD-B and automatic light control is performed by the drive circuit B, since the automatic light control and intensity modulation actuation which were performed by the drive circuit A at time of day t1-t6 about laser diode LD-A, and the contents are the same, explanation is omitted.

[0070] As stated above, according to the gestalt of operation of this invention, it becomes possible to also secure the dynamic range of output voltage, securing the precision at the time of intensity modulation by connecting the suitable resistance computed from the dynamic resistance at the time of actuation of a laser diode between the sources of a PMOS transistor and the power sources which constitute each of two or more current sources.

[0071] Moreover, the maintenance property of control voltage can be improved, without using an external capacitor by the high impedance nature of an MOS transistor, while being able to obtain a low noise, a high speed, and the drive circuit of low cost compared with the conventional discharge current source which it was also easy to make a discharge current source using a PMOS transistor, and the cathode was connected in common like especially a laser diode array, and combined the absorption current source and the discharge current source when a discharge current source was required, since a drive circuit and the holding circuit of control voltage are produced with a CMOS transistor.

[0072] Furthermore, fluctuation of the gate potential of the PMOS transistor which constitutes the current source produced in case a current source turns on and turns off at the time of intensity modulation can be controlled by connecting the capacitor which has a sufficiently larger capacity than the total capacity between the gate drains of the PMOS transistor which constitutes a current source between the gates of a PMOS transistor and the power sources which constitute a current source.

[0073] Moreover, the volt ampere characteristic of the laser diode linked to a current switch's laser connection and reverse side and a direct current and the impedance in the operating point omit. Fluctuation of the drain potential of the PMOS transistor which constitutes a current source by connecting an equal dummy load can be made small. And the gate of the PMOS transistor which constitutes each of two or more current sources By driving with the buffer which has an output impedance from which the time constant expressed with a product with the total capacity of the capacity between gate drains of these PMOS transistors and addition capacity serves as an about 1-pixel modulation period of a laser modulation period Image quality degradation by the precision fall of the intensity modulation at the time of stopping fluctuation of the gate potential of the PMOS transistor which constitutes the current source which it cannot finish pressing down by the capacitor for fluctuation prevention of the above-mentioned gate potential within the 1-pixel modulation period of a laser modulation, and being applied to a laser xerography It can press down to the minimum.

[0074] Furthermore, the reference potential according to individual for every laser diode required of a laser diode array One reference potential is made into the reference potential of the comparator of one drive circuit. The reference potential of the comparator of other drive circuits offset of the quantity of light control system containing the comparator to which one reference potential given previously, respectively was connected, and offset with each quantity of light control system containing the comparator of each other drive circuits, since difference is added to a previous reference potential and given If the difference of offset is set as the beginning, the output quantity of light of all the laser diodes of a laser diode array is correctly controllable by adjusting only the one above-mentioned reference potential after that.

[Translation done.]

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The circuit diagram showing the configuration of the laser diode driving gear concerning the gestalt of operation of this invention.
[Drawing 2] The timing diagram for explaining actuation of the laser diode driving gear shown in drawing 1 .
[Drawing 3] The circuit diagram showing the configuration of the important section of the conventional laser diode driving gear using a discharge mold current source.
[Drawing 4] The circuit diagram showing the configuration of the important section of the conventional laser diode driving gear using two or more discharge mold current sources.
[Drawing 5] The circuit diagram showing the configuration of the important section of the conventional laser diode driving gear using a PMOS transistor.
[Drawing 6] The circuit diagram showing the example of a configuration of the sample hold circuit using an MOS transistor.
[Drawing 7] The explanatory view showing relation with the PN-junction surface ratio of the earth side the power-source side of the MOS transistor which constitutes the convergence electrical potential difference and switch in a switch terminal by the side of the capacitor in the control voltage maintenance condition in a sample hold circuit.
[Description of Notations]
LD-A Laser diode LD-B Laser diode
PD Photodiode 60 Comparator
62 Inverter 64 Buffer Amplifier
66 Inverter 68 Inverter
70 Inverter 72 Inverter
76 Current Switch 78 Current Switch
80 Current Source 82 Current Source
84 Source of Bias Current 86 Source of Bias Current
88 Switch 90
90 Drive Current Control Voltage Maintenance Means
100 Reference Supply 160 Comparator
200 Reference Supply

[Translation done.]

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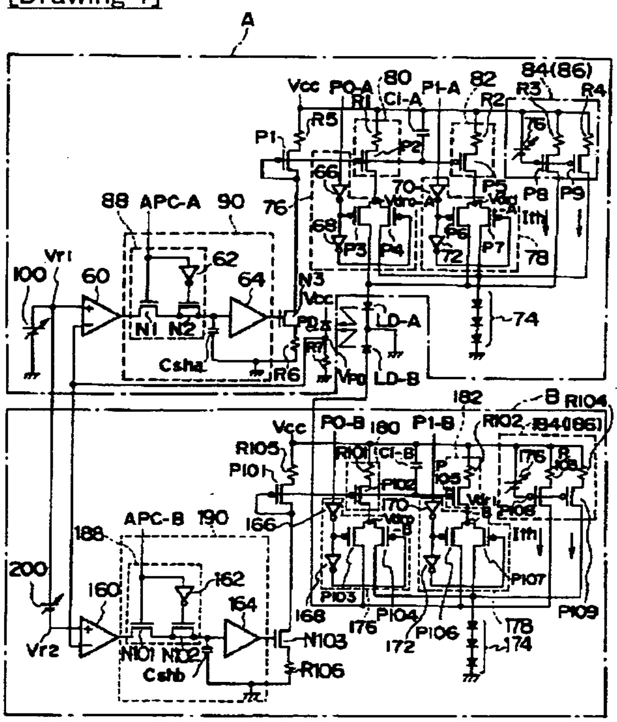
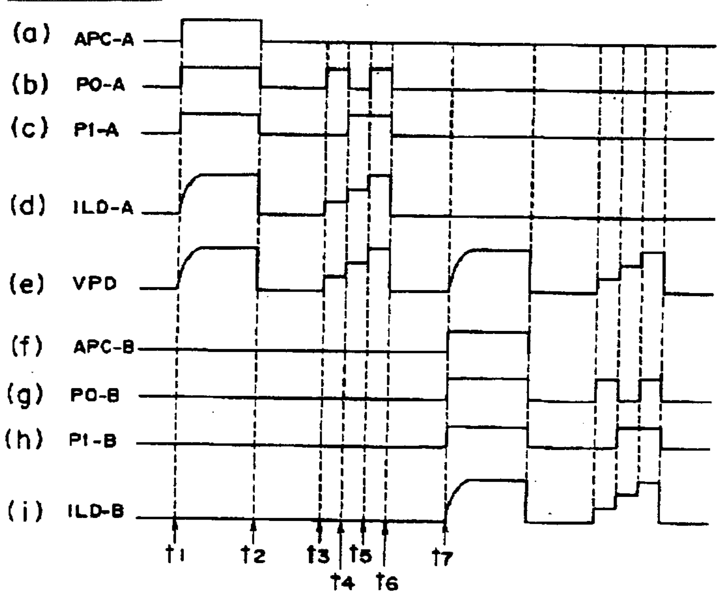
DRAWINGS

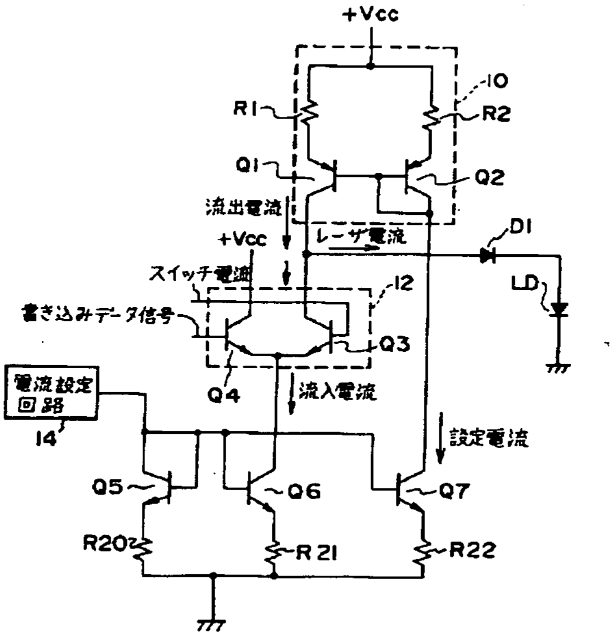
[Drawing 1]



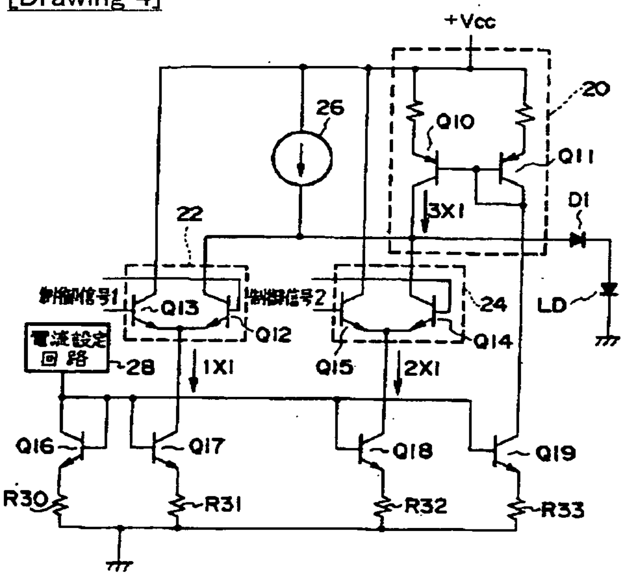
[Drawing 2]



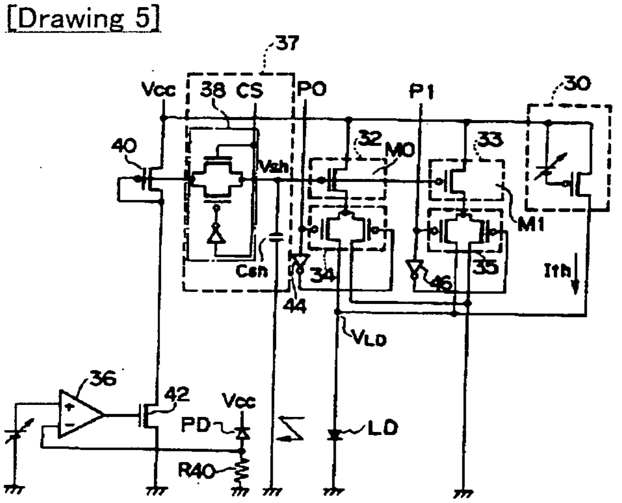
[Drawing 3]



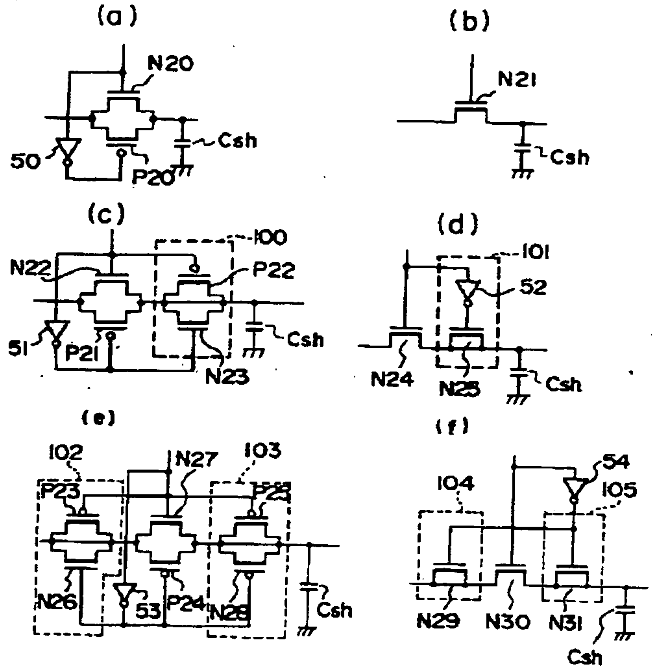
[Drawing 4]



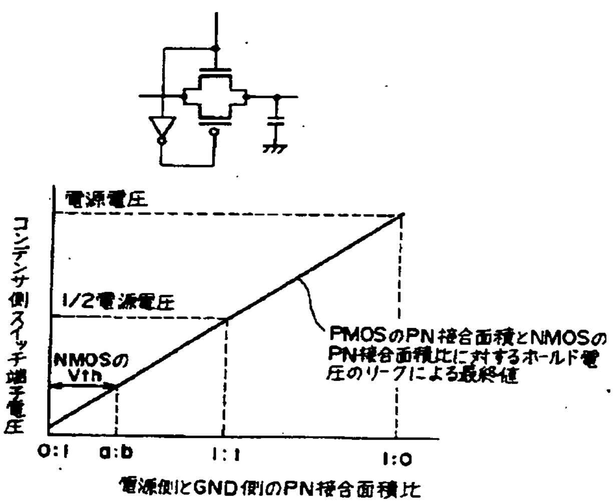
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]

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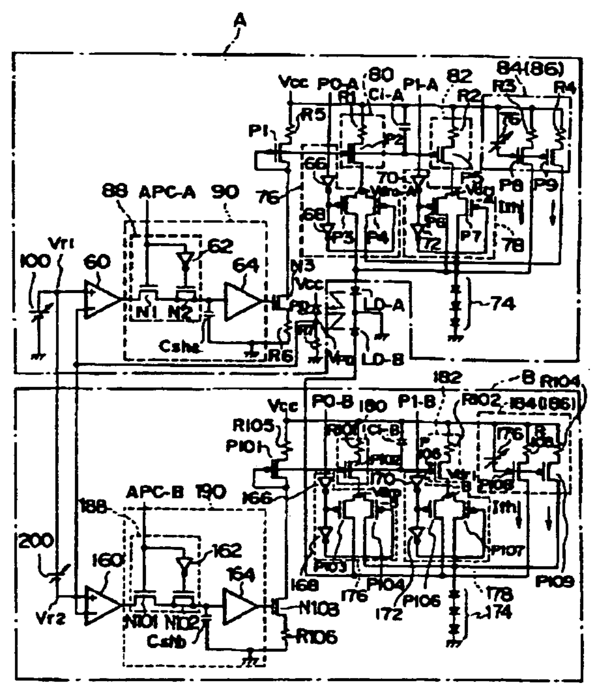
(54)【発明の名称】　レーザダイオード駆動装置及びレーザダイオードの駆動方法

(57)【要約】

【課題】　レーザダイオード、特にレーザダイオードアレーでカソードが共通になったレーザダイオードを高精度に強度変調すること。

【解決手段】　複数の電流源８０、８２を構成するＭＯＳトランジスタＰ２，Ｐ５のソースと電源Ｖccとの間に、それぞれＭＯＳトランジスタＰ２，Ｐ５のトランジスタ比Ｗ／Ｌとその抵抗値の逆数との比が同じであり、かつレーザダイオードＬＤ－Ａ側から見た複数の各電流源８０、８２の出力抵抗の抵抗値がレーザダイオードを駆動可能で変調動作時の前記レーザダイオードの微分抵抗値より十分大きくなる抵抗値を有する抵抗Ｒ１，Ｒ２を接続する。



【特許請求の範囲】

【請求項１】　レーザダイオードの光量制御のための基準電圧とレーザダイオードの発光量の検出出力とを比較する比較手段の比較結果に基づいてレーザダイオードの発光量が基準電圧に対応する値になるようにレーザダイオードを自動光量制御した後、画像信号に基づいてレーザ光を変調するレーザダイオード駆動装置において、

前記自動光量制御終了時の比較手段の出力を保持する保持手段と、

各々該保持手段の出力を受けるゲートが共通接続されたＭＯＳトランジスタと該ＭＯＳトランジスタのソースと接地または電源との間に接続された抵抗とで構成されると共に、レーザダイオードを駆動するための駆動電流を供給する複数の電流源と、

該複数の電流源の各々とレーザダイオードとの間に設けられた複数の第１のスイッチ手段と、

前記画像信号に基づいて前記複数の第１のスイッチ手段を選択的に動作させることにより前記レーザダイオードに供給する駆動電流を変調する制御手段と、を有し、

前記複数の電流源の各々を構成するＭＯＳトランジスタと前記抵抗において、ＭＯＳトランジスタのゲート幅Ｗとゲート長Ｌとの比であるトランジスタ比Ｗ／Ｌと前記抵抗の抵抗値の逆数との比が同じであり、かつレーザダイオード側から見た前記複数の電流源の出力抵抗値がレーザダイオードを駆動可能で変調動作時の前記レーザダイオードの微分抵抗値より十分大きくなる値にしたことを特徴とするレーザダイオード駆動装置。

【請求項２】　請求項１に記載のレーザダイオード駆動装置において、前記複数の電流源の各々を構成するＭＯＳトランジスタのゲートと接地または電源との間に、前記各ＭＯＳトランジスタのドレイン・ゲート間容量の総容量の１６倍より大きく２５６倍より小さい容量を有するコンデンサを接続し、

前記保持手段を、

前記比較手段の出力端に一端が接続される第２のスイッチ手段と、

前記各ＭＯＳトランジスタのドレイン・ゲート間容量と前記コンデンサの容量との総容量との積で表される時定数がおよそ画像信号の一画素の周期となる出力抵抗を有し、前記第２のスイッチ手段の他端にその入力端が接続され入力段がＭＯＳトランジスタで構成されたバッファアンプと、

該バッファアンプの入力端に一端が接続され他端が接地される前記比較手段の出力を保持するコンデンサとで構成し、

前記複数の第１のスイッチ手段の各々を、ソースが共通接続されて前記複数の電流源の各々の出力側に接続されゲートが相補信号で駆動される２つのＭＯＳトランジスタから成る差動型電流スイッチであり、該２つのＭＯＳトランジスタの一方のドレインを前記レーザダイオードに接続し、相補的にオンした際の両ドレイン電圧が等しくなるように他方のドレインに直流の電圧電流特性及び動作点でのインピーダンスが前記レーザダイオードと略等しい負荷を接続したことを特徴とするレーザダイオード駆動装置。

【請求項３】　請求項２に記載のレーザダイオード駆動装置において、

前記保持手段を構成する第２のスイッチ手段はＭＯＳトランジスタで構成され、

前記第２のスイッチ手段を構成するＭＯＳトランジスタのソース・ドレインのＰＮ接合において、電源側に接続されるＰ型ＭＯＳトランジスタの基板と該トランジスタのソース・ドレインとのＰＮ接合面積と、接地側に接続されるＮ型ＭＯＳトランジスタの基板と該トランジスタのソース・ドレインとのＰＮ接合面積との比が前記第２のスイッチ手段がオフ状態にあり、前記レーザダイオードが発光している時に該レーザダイオードの発光量が時間と共に減少する方向に変化するように設定されていることを特徴とするレーザダイオード駆動装置。

【請求項４】　レーザダイオードの発光量を検出する単一の光検出手段を複数のレーザダイオード駆動装置で共用するように構成され、かつレーザダイオードの光量制御のための基準電圧と前記光検出手段の検出出力とを比較する比較手段の比較結果に基づいて複数のレーザダイオードの発光量が基準電圧に対応する値になるように複数のレーザダイオードを時分割で光量制御するレーザダイオードの駆動方法において、

前記複数のレーザダイオードのうちのいずれか一つのレーザダイオードの光量制御のための基準電圧を該一つのレーザダイオードを駆動するレーザダイオード駆動装置の比較手段に与え、残りの他のレーザダイオードを駆動するレーザダイオード駆動装置の各比較手段へはそれぞれ、前記基準電圧に該基準電圧が与えられる比較手段を含む光量制御系が有するオフセット電圧と前記残りの他の各レーザダイオードを駆動するレーザダイオード駆動装置の各比較手段を含む各光量制御系が有するオフセット電圧との差を加えた値を基準電圧として与えることを特徴とするレーザダイオードの駆動方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はレーザダイオードアレーを用いレーザダイオードの発光光量を変化させながら感光体に像を形成する画像形成装置に使用するに好適なレーザダイオード駆動装置及びレーザダイオードの駆動方法に関する。

【０００２】

【従来の技術】近年例えばレーザゼログラフィーにおいてレーザダイオード等の半導体レーザ素子の光出力をマルチビーム化することで画像出力を高速化したり、また光通信においても異なる波長の半導体レーザ素子を同一

チップ上に作り込み、波長の多重化によって光通信速度を向上させる試みがなされている。

【０００３】

【発明が解決しようとする課題】ところでこのような用途に使用されている複数のレーザダイオードを同一基板上に形成したレーザダイオードアレーは一般にカソードが共通に接続されている。これはＮタイプの基板を使用した方がレーザダイオードの等価直列抵抗が下げられ高速化駆動ができること及び歩留りの点でも有利であるという理由による。

【０００４】一方、このようなカソードが共通に接続されたレーザダイオードアレーを駆動するには吐き出し型の電流源が必要である。従来、レーザダイオードを駆動する電流源にはバイポーラトランジスタか化合物半導体のＭＥＳＦＥＴが用いられてきた。これらのプロセスで吐き出し型電流源を作ろうとすると、バイポーラトランジスタで構成するにはＰＮＰトランジスタが必要となるが、通常使用されるラテラル型ＰＮＰトランジスタでは高速駆動ができない。

【０００５】一方、高速駆動が可能なバーチカル型ＰＮＰトランジスタは製造プロセスが複雑で高価である。また化合物半導体の場合にはホールの移動度が小さく、たとえＰチャンネル型ＦＥＴができても化合物半導体を使うメリットはない。したがって吐き出し型の電流源でレーザダイオードを高速駆動したい場合には、たとえば図3に示すようにトランジスタＱ１，Ｑ２、抵抗Ｒ１，Ｒ２からなるスイッチングしない吐き出し型電流源１０とトランジスタＱ３，Ｑ４からなる高速スイッチングが可能な電流スイッチ１２を直列に接続し、電流スイッチ１２のトランジスタＱ３をオンすることによりトランジスタＱ６側に電流源１０からの流出電流を流入させてレーザダイオードＬＤへ電流が流れるのを停止し、電流スイッチ１２のトランジスタＱ３をオフすることにより電流源１０よりダイオードＤ１を介してレーザダイオードＬＤへ電流が流れるようにする（特開平４－２４０７８７号公報、特開平６－１３９６０７号公報）。

【０００６】この方式では動作速度の遅い吐き出し型電流源をスイッチングする必要がなく、また吐き出し型電流源をインダクタンスを介して電流スイッチと接続することで吐き出し型電流源の出力容量がレーザダイオードの出力の変調速度に影響しないようように構成することができる。

【０００７】しかしこの方式で図４に示すように複数の電流スイッチ２２、２４とこれらに直列接続された電流源Ｑ１７、Ｑ１８とを並列接続したものを吐き出し型電流源２０、２６に直列に接続し、複数の電流スイッチ２２、２４を選択的に駆動することによりレーザダイオードの出力を強度変調した場合において、レーザダイオードの出力を低くした場合にノイズが増大するという問題が生じる。

【０００８】すなわち、図４に示す電流源は、レーザダイオードＬＤの閾値電流が設定されたバイアス電流源２６と、吸い込み型電流源２２の吸い込み電流Ｉを基準にして出力電流が３×Ｉの吐き出し型電流源２０と、吸い込み電流が１×Ｉの吸い込み型電流源２２、吸い込み電流が２×Ｉの吸い込み型電流源２４の二つの吸い込み型電流源を使用し、０、１×Ｉ，２×Ｉ，３×Ｉの４レベルの強度変調が可能な電流源を構成している。図４において、バイアス電流源２６によりレーザダイオードＬＤには閾値電流が供給されている。ここに閾値電流とは半導体レーザ素子が駆動される際に自然発光状態からレーザ発振状態に移行する点において半導体レーザ素子に流れる電流をいう。トランジスタＱ１２，Ｑ１４をそれぞれ導通状態または非導通状態になるように制御する制御信号１、２が入力されることにより吸い込み型電流源２２、２４のトランジスタＱ１２，Ｑ１４が非導通状態になった場合について考える。この場合には吐き出し型電流源２０から流出する吐き出し電流３×Ｉは、二つの吸い込み電流源２２、２４のトランジスタＱ１２，Ｑ１４が非導通状態にあるためすべてレーザダイオードＬＤに流れる。

【０００９】次に制御信号２により吸い込み型電流源２４のトランジスタＱ１４が導通状態にされると、吸い込み型電流源２４が駆動されるので、レーザダイオードＬＤには吐き出し電流３×Ｉから吸い込み型電流源２４による吸い込み電流２×Ｉを差し引いた電流Ｉが流れる。ところでこの時トランジスタで発生するショットノイズを考えると、制御信号１、２により吸い込み型電流源２２、２４のトランジスタＱ１２，Ｑ１４が非導通状態になり、吐き出し型電流源２０から流出する吐き出し電流３×ＩがレーザダイオードＬＤにすべて流れる時には√（３×Ｉ）でＳ／Ｎ比は３√Ｉ／√３倍となる。

【００１０】ところが制御信号２により吸い込み型電流源２４のトランジスタＱ１４が導通状態にされ、吐き出し電流３×Ｉの内の１×ＩのみがレーザダイオードＬＤに流れた場合、吐き出し型電流源２０側と吸い込み型電流源２４側でノイズに相関がないことからショットノイズは吐き出し型電流源２０側の√（３×Ｉ）の二乗とと吸い込み型電流源２４側の√（２×Ｉ）の二乗との和５Ｉの平方根√（５×Ｉ）となりこの時のＳ／Ｎ比は√Ｉ／√５倍に低下する。このことから判るように、この方式で強度変調を行った場合、特にレベルが小さいほどＳ／Ｎ比が低下する。これはレーザゼログラフィーにおける画質やあるいは多値のレーザ光通信などで問題になる。これらの理由からバイポーラトランジスタのＮＰＮトランジスタやＭＥＳＦＥＴのＮチャンネル型電界効果トランジスタにより構成された吸い込み型電流源を利用して吐き出し型電流源を構成することには問題があった。

【００１１】一方、特開平７－３３５９５７号公報や特

開平8－293837号公報にはMOSFETによるレーザドライバーが記載されている。CMOSならPMOSトランジスタとNMOSトランジスタの両方を作り込むことが可能で、しかもゲート長の微細化によって近年バイポーラトランジスタに近い相互コンダクタンスgmが得られるようになってきた。

【0012】課題1）ところがゲート長の微細化によりMOSトランジスタのドレイン電流がピンチオフ領域でドレイン・ソース間電圧に依存する傾向が大きくなった。これはMOSトランジスタで定電流源を構成し動作させる場合にレーザダイオードに供給する電流が変化するとレーザダイオードの端子電圧が変化し、その結果電流源の電流値が変動し、強度変調での入力データに電流源の出力電流が正確に比例しなくなるという問題がある。

【0013】課題2）図5にPMOSを使用した強度変調可能な吐き出し型電流源を有するレーザダイオード駆動装置の構成を示す。同図において、バイアス電流源30によりレーザダイオードLDの閾値電流I_{th}が設定され、重み付けした吐き出し型電流源32（吐き出し電流1×I）、吐き出し型電流源33（吐き出し電流2×I）を吐き出し型電流源32、33に接続された電流スイッチ34、35を制御信号P0，P1で制御することで強度変調が可能になる。強度変調のための各吐き出し型電流源32、33を構成するPMOSトランジスタのゲート電位は、変調を開始する前にサンプルホールド回路37を構成するCMOSスイッチ38を制御信号CSをハイレベルにすることによりオンにし、レーザダイオードLDの出力光を受光したフォトダイオードPDの出力を比較器36に負帰還することにより決定され、その値をCMOSスイッチ38をオフにしてコンデンサC_{sh}に保持し、変調時の制御電圧V_{sh}とする。特にMOSFETはゲート入力インピーダンスが高いので図5に示すように変調時の制御電圧が保持されるコンデンサC_{sh}の端子に直接接続することができる。

【0014】ところが従来2値のパルス幅変調では問題にならなかったことが強度変調を行う場合に問題になる。たとえば図5の例で制御信号P1をハイレベルからローレベルにすると、電流源33を構成するPMOSトランジスタM1のドレイン電圧V_{dr1}は接地電位からレーザの端子電圧V_{LD}に上昇する。このドレイン電圧V_{dr1}の変化は電流源33を構成するトランジスタM1のドレイン・ゲート間容量を介して制御電圧V_{sh}を上昇させる。その結果、電流源32、33の出力電流値は減少する。このように強度変調のため電流スイッチを開閉することにより制御電圧V_{sh}が変化し、変調データに対し出力電流が正確に対応しなくなるという問題点があった。

【0015】課題3）レーザダイオードに駆動電流を供給する電流源をMOSトランジスタで構成すると共に、変調期間中に電流源制御電圧を保持するサンプルホールド回路もMOSトランジスタで構成すると電流安定性を格段に向上することができる。特にレーザダイオードアレーを利用し高速書き込みを行うレーザゼログラフィーではそのメリットが大きい。レーザダイオードアレーの変調前の光量制御はレーザダイオードの出力光を受光するフォトダイオードが複数のレーザダイオードに対し一つしかないため通常、時分割で光量を設定している。時分割で光量制御する方法としては大別して二つある。一つは1ラインごとに光量制御するレーザダイオードを切り替える方式で、1ライン中に占める光量制御に要する時間はシングルレーザと変わらないものの、光量制御すべきレーザダイオードの数が多いほど、次の光量制御までの時間が長いため、変調期間中にコンデンサに保持されている電流源制御電圧のドループ（電圧変動）が問題となる。

【0016】一方もう一つの方法は1ライン中に毎回全部のレーザダイオードを光量制御する方法で、この場合1ラインごとにすべてのレーザダイオードが光量制御されサンプルホールド回路のサンプルホールド用コンデンサが充電され直すためサンプルホールド回路のドループが問題になることはない。

【0017】しかし1ライン中に占める光量制御の時間はレーザダイオードの数が多いほど長くなり、画像を書き込むための変調期間をその分短くしなければならず、描画速度の低下を招く。従ってレーザゼログラフィーの性能を低下させないためにはサンプルホールド回路のドループ特性を改善する必要がある。

【0018】ドループの問題は、従来のシングルレーザでしかもパルス幅変調のみの場合レーザの走査方向の光量変動が走査毎に常に一定であったためレーザゼログラフィへの応用では視覚上大きな問題とならなかった。ところがレーザの走査方向と直角の副走査方向に並べたレーザダイオードアレーを用いて、一回の走査毎にレーザダイオードを切り替えてレーザダイオードの光量制御を行う場合には、レーザダイオードアレーの隣接するレーザダイオード同士で光量制御のタイミングが異なり、僅かのドループが画質に影響を及ぼすためドループを更に抑制する必要があった。MOSトランジスタはバイポーラトランジスタに比べると桁違いにドループ特性の優れたサンプルホールド回路を容易に作ることができる。

【0019】ところでサンプルホールド回路には図6（a）に示すように通常，CMOSプロセスならばCMOSスイッチが用いられる。これはスイッチのオン抵抗がスイッチの端子電圧に依存しないようにするためである。図6において、図6（a）はCMOSスイッチ、図6（b）はNMOSスイッチ、図6（c）、（e）はCMOSノイズキャンセラ付きスイッチ、図6（d）、（f）はNMOSノイズキャンセラ付きスイッチ、をそれぞれ用いたサンプルホールド回路を示している。図6において100～105はノイズキャンセラである。

【００２０】一般的にＣＭＯＳスイッチのＰＭＯＳトランジスタとＮＭＯＳトランジスタのトランジスタサイズは二つの観点で決められる。一つはスイッチングノイズ（ゲートからの容量結合を介して生ずる電荷の漏れ込み）を最小にする場合で、ＰＭＯＳトランジスタとＮＭＯＳトランジスタのゲート幅を等しく設計する。こうするとＰＭＯＳトランジスタとＮＭＯＳトランジスタのゲートからのフィードスルーが逆極性のためＰＭＯＳトランジスタとＮＭＯＳトランジスタに生ずるスイッチングノイズは相殺する。　しかしこの方式でスイッチングノイズが厳密に相殺されるのはゲート下の反転層の広がりがＰＭＯＳトランジスタとＮＭＯＳトランジスタで等しくなる電源電圧のほぼ１／２のときだけで、その他の電圧ではＣＭＯＳスイッチ両端の反転層によるフィードスルーがＰＭＯＳトランジスタとＮＭＯＳトランジスタとで異なるため相殺されない。このため電源電圧によらずスイッチングノイズを減らしたい場合はＭＯＳトランジスタのゲート幅を半分にしたダミーのＭＯＳトランジスタをコンデンサＣsh側の端子に接続したり、更にノイズキャンセルの効果を上げるため比較器出力との間にもゲート幅を半分にしたダミーのＭＯＳトランジスタを接続することも行われる。

【００２１】もう一つの観点はオン抵抗の電源電圧依存性を小さくする場合で、ＣＭＯＳスイッチを構成するＰＭＯＳトランジスタとＮＭＯＳトランジスタのゲートのゲート幅をＷ、ゲート長をＬとしてＷ／Ｌの比（トランジスタ比）をホールと電子のモビリティの逆数比で設計する。こうするとＣＭＯＳスイッチの両端の電位が電源電圧に一致した場合のＰＭＯＳトランジスタのオン抵抗と、ＣＭＯＳスイッチ両端の電位が接地電位に一致した場合のＮＭＯＳトランジスタのオン抵抗の値が等しくなる。ＣＭＯＳスイッチでは通常低いオン抵抗と、低いスイッチングノイズが要求されるためＣＭＯＳスイッチを構成するＰＭＯＳトランジスタとＮＭＯＳトランジスタは最小で等しいチャンネル長で設計する。このためいずれの観点で設計してもＰＭＯＳトランジスタとＮＭＯＳトランジスタの幅が等しいか、またはＰＭＯＳトランジスタのゲート幅が大きくなる。その結果、単位面積当たりのＰＮ接合リークがＰＭＯＳトランジスタとＮＭＯＳトランジスタとで略、等しいとすると、サンプルホールド回路がホールド状態のまま放置された場合、ＰＭＯＳトランジスタではＮ基板が電源に接続されているため、このＮ基板とソース・ドレインであるＰ層とのＰＮ接合を通してリーク電流がサンプルホールド用コンデンサＣshに流れ込み、ＮＭＯＳトランジスタではＰ基板が接地されているため、このＰ基板とソース・ドレインであるＮ層とのＰＮ接合を通してリーク電流がサンプルホールド用コンデンサＣshから流れ出す。この結果、サンプルホールド回路の出力はＮＭＯＳトランジスタ、ＰＭＯＳトランジスタのソース・ドレインのＰＮ接合からのリークで図７に示すように１／２電源電圧以上の電圧に収束する。この電圧でＣＭＯＳスイッチのＮＭＯＳトランジスタを駆動すると過大電流がレーザダイオードに流れレーザダイオードを破壊するという問題があった。

【００２２】課題４）レーザダイオードアレーの自動光量制御では、すでに述べたように複数のレーザダイオードに対して一つのフォトダイオードを使用して時分割で光量制御する。したがって、それぞれのレーザダイオードの自動光量制御はレーザダイオードの光出力を検出する一つのフォトダイオード出力と、レーザダイオードの発光量の目標値に対応する一つの基準電圧とを誤差検出手段としての比較器で比較すればよい。しかし実際には自動光量制御のために用いられる複数の比較器は個々にオフセットが異なっているため、各比較器の基準電圧は個々の比較器に合わせる必要があり、基準電圧を変更する度に各レーザダイオード毎に調整する必要があった。

【００２３】本発明はこのような事情に鑑みてなされたものであり、強度変調精度の向上を図ったレーザダイオード駆動装置を提供することを第１の目的とする。

【００２４】また本発明は制御系の停止等の動作不良によりレーザダイオードの駆動電流を制御する制御電圧を保持する保持手段（サンプルホールド回路）が制御電圧の保持状態を継続しても発光中のレーザダイオードが過電流により損傷するのを防止することができるレーザダイオード駆動装置を提供することを第２の目的とする。

【００２５】更に本発明はレーザダイオードの発光光量を目標値に設定するための一つの基準電圧を調整するだけですべての複数のレーザダイオードの光量を高精度に制御することができるレーザダイオードの駆動方法を提供することを第３の目的とする。

【００２６】

【課題を解決するための手段】第１の目的を達成するために請求項１に記載の発明は、レーザダイオードの光量制御のための基準電圧とレーザダイオードの発光量の検出出力とを比較する比較手段の比較結果に基づいてレーザダイオードの発光量が基準電圧に対応する値になるようにレーザダイオードを自動光量制御した後、画像信号に基づいてレーザ光を変調するレーザダイオード駆動装置において、前記自動光量制御終了時の比較手段の出力を保持する保持手段と、各々該保持手段の出力を受けるゲートが共通接続されたＭＯＳトランジスタと該ＭＯＳトランジスタのソースと接地または電源との間に接続された抵抗とで構成されると共に、レーザダイオードを駆動するための駆動電流を供給する複数の電流源と、該複数の電流源の各々とレーザダイオードとの間に設けられた複数の第１のスイッチ手段と、前記画像信号に基づいて前記複数の第１のスイッチ手段を選択的に動作させることにより前記レーザダイオードに供給する駆動電流を変調する制御手段と、を有し、前記複数の電流源の各々を構成するＭＯＳトランジスタと前記抵抗において、Ｍ

ＯＳトランジスタのゲート幅Ｗとゲート長Ｌとの比であるトランジスタ比Ｗ／Ｌと前記抵抗の抵抗値の逆数との比が同じであり、かつレーザダイオード側から見た前記複数の電流源の出力抵抗値がレーザダイオードを駆動可能で変調動作時の前記レーザダイオードの微分抵抗値より十分大きくなる値にしたことを特徴とする。

【００２７】上記構成のレーザダイオード駆動装置では、レーザダイオードを駆動するための駆動電流を供給する複数の電流源の各々を、ＭＯＳトランジスタと該ＭＯＳトランジスタのソースと接地または電源との間にそれぞれ抵抗を接続して構成し、前記複数の電流源の各々を構成するＭＯＳトランジスタと前記抵抗においてトランジスタ比Ｗ／Ｌと前記抵抗の抵抗値の逆数との比が同じであり、かつレーザダイオード側から見た前記複数の電流源の出力抵抗値がレーザダイオードを駆動可能で変調動作時の前記レーザダイオードの微分抵抗値より十分大きくなる値にしたので、レーザダイオードの駆動電流を強度変調する際にレーザダイオードの端子間電圧の変動による駆動電流の出力変動を抑制でき、レーザダイオードの強度変調精度の向上が図れると共に、レーザダイオードの端子間電圧が大きいレーザダイオードにも対応することが可能になる。実際に市販されている数１０ｍＷの赤外レーザの場合、閾値電流付近でのレーザダイオードの微分抵抗の数Ω～数１０Ωのため例えば、１６階調の強度変調を行う場合、電流源の出力抵抗値が少なくともこれの１６倍以上になるように該抵抗値を調整すればよい。

【００２８】また請求項２に記載の発明は、請求項１に記載のレーザダイオード駆動装置において、前記複数の電流源の各々を構成するＭＯＳトランジスタのゲートと接地または電源との間に、前記各ＭＯＳトランジスタのドレイン・ゲート間容量の総容量の１６倍より大きく２５６倍より小さい容量を有するコンデンサを接続し、前記保持手段を、前記比較手段の出力端に一端が接続される第２のスイッチ手段と、前記各ＭＯＳトランジスタのドレイン・ゲート間容量と前記コンデンサの容量との総容量との積で表される時定数がおよそ画像信号の一画素の周期となる出力抵抗を有し、前記第２のスイッチ手段の他端にその入力端が接続され入力段がＭＯＳトランジスタで構成されたバッファアンプと、該バッファアンプの入力端に一端が接続され他端が接地される前記比較手段の出力を保持するコンデンサとで構成し、前記複数の第１のスイッチ手段の各々を、ソースが共通接続されて前記複数の電流源の各々の出力側に接続されゲートが相補信号で駆動される２つのＭＯＳトランジスタから成る差動型電流スイッチであり、該２つのＭＯＳトランジスタの一方のドレインを前記レーザダイオードに接続し、相補的にオンした際の両ドレイン電圧が等しくなるように他方のドレインに直流の電圧電流特性及び動作点でのインピーダンスが前記レーザダイオードと略等しい負荷を接続したことを特徴とする。

【００２９】上記構成のレーザダイオード駆動装置では、複数の電流源をそれぞれ、２つのＭＯＳトランジスタで構成される差動型電流スイッチである第１のスイッチ手段を介してレーザダイオードに接続し、上記第１のスイッチ手段を選択的に動作させることによりレーザダイオードを駆動する駆動電流を強度変調する際に、上記各第１のスイッチ手段を駆動する相補信号である変調信号のレベルを変化させても前記電流源を構成するＭＯＳトランジスタのドレイン・ゲート間容量の総容量より十分、大きい容量を有するコンデンサを複数の電流源の各々を構成するＭＯＳトランジスタのゲートと接地または電源との間に接続し、かつ二つの第１のスイッチ手段の各々を構成する二つのＭＯＳトランジスタの一方のＭＯＳトランジスタのドレインにレーザダイオードと直流の電圧電流特性及び動作点でのインピーダンスが略等価な負荷を接続することにより複数の電流源の各々を構成するＭＯＳトランジスタのゲートの電圧変動を抑制することができるので、強度変調の精度の向上が図れる。

【００３０】第２の目的を達成するために請求項３に記載の発明は、請求項２に記載のレーザダイオード駆動装置において、前記保持手段を構成する第２のスイッチ手段はＭＯＳトランジスタで構成され、前記第２のスイッチ手段を構成するＭＯＳトランジスタのソース・ドレインのＰＮ接合において、電源側に接続されるＰ型ＭＯＳトランジスタの基板と該トランジスタのソース・ドレインとのＰＮ接合面積と、接地側に接続されるＮ型ＭＯＳトランジスタの基板と該トランジスタのソース・ドレインとのＰＮ接合面積との比が前記第２のスイッチ手段がオフ状態にあり、前記レーザダイオードが発光している時に該レーザダイオードの発光量が時間と共に減少する方向に変化するように設定されていることを特徴とする。第２のスイッチ手段のＭＯＳトランジスタの構成としては図６（ａ）乃至（ｆ）があり、更に同図（ｂ），（ｄ），（ｆ）におけるＮＭＯＳトランジスタをＰＭＯＳトランジスタに置換するように構成しても使用することができる。尚、ＰＭＯＳトランジスタまたはＮＭＯＳトランジスタの基板を各々、電源、接地から浮かせて別の電位にして動作させることも可能である。

【００３１】上記構成のレーザダイオード駆動装置では、発光しているレーザが万が一制御系の停止などによって保持手段により比較手段の出力が保持される状態が変調期間外まで継続しても変調期間内においてレーザダイオードの発光量が時間の経過と共に減少する方向に保持手段の保持電圧が変化するため、過電流によりレーザダイオードが破壊したり、またはレーザダイオードの被照射面が損傷を受けるのを防止できる。

【００３２】第３の目的を達成するために請求項４に記載の発明は、レーザダイオードの発光量を検出する単一の光検出手段を複数のレーザダイオード駆動装置で共用

するように構成され、かつレーザダイオードの光量制御のための基準電圧と前記光検出手段の検出出力とを比較する比較手段の比較結果に基づいて複数のレーザダイオードの発光量が基準電圧に対応する値になるように複数のレーザダイオードを時分割で光量制御するレーザダイオードの駆動方法において、前記複数のレーザダイオードのうちのいずれか一つのレーザダイオードの光量制御のための基準電圧を該一つのレーザダイオードを駆動するレーザダイオード駆動装置の比較手段に与え、残りの他のレーザダイオードを駆動するレーザダイオード駆動装置の各比較手段へはそれぞれ、前記基準電圧に該基準電圧が与えられる比較手段を含む光量制御系が有するオフセット電圧と前記残りの他の各レーザダイオードを駆動するレーザダイオード駆動装置の各比較手段を含む各光量制御系が有するオフセット電圧との差を加えた値を基準電圧として与えることを特徴とする。

【００３３】上記構成のレーザダイオードの駆動方法では、複数のレーザダイオードのうちのいずれか一つのレーザダイオードの光量制御のための一つの基準電圧を該一つのレーザダイオードを駆動するレーザダイオード駆動装置の比較手段に与え、残りの他のレーザダイオードを駆動するレーザダイオード駆動装置の各比較手段へはそれぞれ、前記一つの基準電圧に該基準電圧が与えられる比較手段を含む光量制御系が有するオフセット電圧と前記残りの他の各レーザダイオードを駆動するレーザダイオード駆動装置の各比較手段を含む各光量制御系が有するオフセット電圧との差を加えた値を基準電圧として与え、後は上記一つの基準電圧のみを調整することですべてのレーザダイオードの光量調整を高精度に行うことができる。

【００３４】

【実施例】本発明の実施の形態を図面を参照して説明する。図１には本発明の実施の形態に係るレーザダイオード駆動装置の構成が示されている。本実施の形態に係るレーザダイオード駆動装置は、二つのレーザダイオードＬＤ－Ａ，ＬＤ－Ｂに対しレーザダイオードＬＤ－Ａ，ＬＤ－Ｂの出力光を検出して光電流を出力する光検出手段としての受光素子ＰＤを一つだけ設け、時分割で駆動回路Ａ、駆動回路Ｂによりレーザダイオードの ＬＤ－Ａ，ＬＤ－Ｂを自動光量制御し、かつ強度変調するように構成されている。二つの駆動回路Ａ，Ｂの構成は同一であるため、ここでは駆動回路Ａのみについて説明する。図１においてレーザダイオードＬＤ－Ａ，ＬＤ－Ｂのカソードは共通接続され、接地されている。レーザダイオードＬＤ－Ａのアノードは本発明の第１のスイッチ手段に対応する電流スイッチ７６、７８を介して重み付き電流源８０、８２が接続されている。電流源８０はＰＭＯＳトランジスタＰ２及びＰＭＯＳトランジスタＰ２のソースと電源Ｖccとの間に接続された抵抗Ｒ１より、電流源８２はＰＭＯＳトランジスタＰ５及びＰＭＯＳトランジスタＰ５のソースと電源Ｖccとの間に接続された抵抗Ｒ２より、それぞれ構成されている。電流源８０、８２の出力電流比は１：２に重み付けされており、電流源８０の出力電流を基準にして電流源８０の出力電流は１×Ｉに、また電流源８２の出力電流は２×ＩになるようにＰＭＯＳトランジスタＰ２，Ｐ５のトランジスタ比Ｗ／Ｌ（Ｗはゲート幅、Ｌはゲート長である。）が設定されている。

【００３５】また電流源８０、８２の出力抵抗を形成する抵抗Ｒ１、Ｒ２の抵抗値は、それぞれその逆数とＰＭＯＳトランジスタＰ２、Ｐ５のトランジスタ比Ｗ／Ｌとの比が等しく、かつレーザダイオードＬＤ－Ａ側から見た電流源８０、８２の出力抵抗の抵抗値がレーザダイオードＬＤ－Ａを駆動可能で変調後動作時のレーザダイオードＬＤ－Ａの微分抵抗値より十分、大きくなる値、例えば１６階調の強度変調を行う場合、前記微分抵抗値の１６倍から２５６倍の値が選択される。ここで上限を２５６倍としたのはレーザダイオードのＳ／Ｎ比が種々のノイズ源により受光器出力で４０ｄＢ程度であり、これ以上増大させても抵抗Ｒ１，Ｒ２での電圧降下で電源電圧のマージンがなくなるだけだからである。

【００３６】電流スイッチ７６は、ソースが共通接続され電源８０を構成するＰＭＯＳトランジスタＰ２のドレインに接続される二つのＰＭＯＳトランジスタＰ３，Ｐ４及びインバータ６６、６８より構成されている。

【００３７】また電流スイッチ７８は、ソースが共通接続され電源８２を構成するＰＭＯＳトランジスタＰ５のドレインに接続される二つのＰＭＯＳトランジスタＰ６，Ｐ７及びインバータ７０、７２より構成されている。電流スイッチ７６、電流スイッチ７８は、それぞれＰＭＯＳトランジスタＰ３，Ｐ４、あるいはＰＭＯＳトランジスタＰ６，Ｐ７、のゲートが相補信号で駆動される差動型電流スイッチである。

【００３８】電流スイッチ７６，７８のＰＭＯＳトランジスタＰ３，Ｐ６のドレインはレーザダイオードＬＤ－Ａのアノードに、電流スイッチ７６，７８のＰＭＯＳトランジスタＰ４，Ｐ７のドレインはダミーロード７４の一端にそれぞれ、接続されている。ダミーロード７４の他端は接地されている。

【００３９】電流スイッチ７６のＰＭＯＳトランジスタＰ３のゲートにはインバータ６６を介して、ＰＭＯＳトランジスタＰ４のゲートにはインバータ６６、６８を介してそれぞれ、制御信号Ｐ０－Ａが入力されるように構成されている。また電流スイッチ７８のＰＭＯＳトランジスタＰ６のゲートにはインバータ７０を介して、ＰＭＯＳトランジスタＰ７のゲートにはインバータ７０、７２を介してそれぞれ、制御信号Ｐ１－Ａが入力されるように構成されている。電流スイッチ７６、７８は制御信号Ｐ０－Ａ，Ｐ１－Ａでスイッチング制御され、レーザダイオードＬＤ－Ａを強度変調するようになっている。

電流スイッチ７６，７８を構成する各ＰＭＯＳトランジスタＰ３、Ｐ４、Ｐ６、Ｐ７のゲートはインバータ６８、７２により相補的に駆動されることでスイッチがオフする際にコンデンサＣｉ－Ａの保持するレーザダイオードＬＤ－Ａの駆動電流を制御する制御電圧がスイッチ制御信号のフィードスルーで過渡的にシフトするのを防止する。

【００４０】本実施の形態では、変調レベルはレベルゼロを含めて４レベルの強度変調であるが、さらに重み付電流源を増加することにより強度変調レベルを増加することが可能である。また本実施の形態にかかるレーザダイオード駆動装置では駆動回路をＣＭＯＳプロセスで作製するので、ＰＭＯＳトランジスタを用いて電流源８０、８２、電流スイッチ７６、７８を構成した吐き出し型電流源を作ることが容易で、特にレーザダイオードアレイのようにカソードが共通に接続され吐き出し型電流源が必要な場合、吸い込み型電流源と吐き出し型電流源とを組み合わせた従来の吐き出し型電流源に比較して低ノイズ、高速で、かつ低コストの駆動回路、延いてはレーザダイオード駆動装置を得ることができる。

【００４１】更にレーザダイオードＬＤ－Ａのアノードには可変電源７６、ＰＭＯＳトランジスタＰ８及び抵抗Ｒ３からなるバイアス電流源８４が接続されており、バイアス電流源８４により常時、レーザダイオードＬＤ－Ａに閾値電流Ｉthが供給されるように構成されている。

【００４２】またダミーロード７４の一端には可変電源７６、ＰＭＯＳトランジスタＰ９及び抵抗Ｒ４からなるバイアス電流源８６が接続されており、バイアス電流源８６により常時、ダミーロード７４にもバイアス電流が供給されるように構成されている。バイアス電流源８６は強度変調しレーザダイオードＬＤ－Ａの端子電圧が変化した際、同様にダミーロード７４の端子電圧も変動し、電流源８０、８２の出力ノードにおける電位Ｖｄｒ０－Ａ，Ｖｄｒ１－Ａの変動が強度変調領域すべてで最小にするためのものである。したがって強度変調の要求精度により省略することも可能である。

【００４３】ダミーロード７４は電流スイッチ７６、７８をオン、オフした際に電流源８０、８２の出力ノードにおける電位Ｖｄｒ０－Ａ，Ｖｄｒ１－Ａが直流的にもまた過渡的にも変動が小さくなるように、すなわち、直流の電圧電流特性及び動作点でのインピーダンスがレーザダイオードＬＤ－Ａと略、等しくなるような負荷としてダイオード、抵抗、コンデンサ、インダクタンスを用いて構成されている。したがって、電流スイッチ７６、７８をオン、オフした際に電流源８０、８２の出力ノードにおける電位Ｖｄｒ０－Ａ，Ｖｄｒ１－Ａの変動が抑制される。

【００４４】ＰＤはレーザダイオードＬＤ－Ａの発光量を検出する光検出手段として機能するフォトダイオードであり、例えば、複数のレーザダイオードと共にパッケージ内に実装され、レーザダイオードの背面からの光を受光するＰＩＮフォトダイオードが使用される。フォトダイオードＰＤはアノードがフォトダイオードＰＤにより出力される光電流を電圧に変換する電流電圧変換手段としての抵抗Ｒ７を介して接地され、カソードは電源Ｖccに接続されている。

【００４５】６０はレーザダイオードＬＤ－Ａの発光光量の目標値である基準電圧を生成する基準電源１００により設定される基準電圧Ｖr1と抵抗Ｒ７により電流電圧変換されたレーザダイオードＬＤ－Ａの発光光量に応じた電圧とを比較しその偏差に応じた電圧を出力する本発明の比較手段に対応する比較器である。この比較器は演算増幅器により構成されている。　基準電圧Ｖr1はレーザダイオードＬＤ－Ａの自動光量制御時にレーザダイオードＬＤ－Ａの発光光量を光量計で測定しながら基準電源１００により設定する。しかし厳密には比較器は演算増幅器で構成されており、比較器入力にはオフセットがあり、更にスイッチ６２ではオフする際ＮＭＯＳトランジスタＮ１，Ｎ２のゲート信号からの漏れ込みで電圧が変動するため、実際設定される基準電圧はフォトダイオードＰＤの光電流出力により抵抗Ｒ６の両端に生ずる電圧に比較器６０を含む光量制御系のオフセット電圧が加わった値となる。特に比較器の入力オフセット電圧は比較器ごとにばらつくためレーザダイオードの光量制御の精度を上げるためには個々に基準電圧を設けたほうがよいが煩雑である。そこで本実施の形態ではオフセットがレーザダイオードの駆動条件に大きく影響されないことを利用し、一方の基準電圧Ｖr1に対し、もう一方の駆動回路Ｂの比較器１６０に供給される基準電圧Ｖr2を比較器６０、１６０の入力オフセット電圧の差を加えて印加するように構成されている。すなわち、基準電圧Ｖr2は比較器６０、１６０の入力オフセット電圧の差だけが設定される。これにより一方の基準電圧（本実施の形態では比較器６０の基準電圧Ｖr1）を調整するだけで精度よく両方のレーザダイオードＬＤ－Ａ、ＬＤ－Ｂの発光光量を高い精度で設定することができる。本実施の形態ではレーザダイオード駆動駆動回路（レーザダイオード駆動装置）は二つであるが、これがｎ個のレーザダイオード駆動回路によりｎ個のレーザダイオードを時分割で光量制御する場合においても、同様である。すなわち、レーザダイオードの発光光量を検出する単一の光検出手段であるフォトダイオードＰＤを他のレーザダイオード駆動装置と共用するように構成されたレーザダイオードの光量制御のための基準電圧と前記光検出手段の検出出力とを比較する誤差検出手段としての比較器を有する複数のレーザダイオード駆動装置１，…，ｎ（ｎ≧２）により複数のレーザダイオード１，…，ｎ（ｎ≧２）を時分割で光量制御する場合において、レーザダイオード１の光量制御のための基準電圧１をレーザダイオード駆動装置１の比較手段（比較器）に与え、レーザダイオード駆

動装置ｎへは基準電圧１にレーザダイオード駆動装置１の比較手段の入力オフセット電圧とレーザダイオード駆動装置ｎの比較手段の入力オフセット電圧との差を加えた値を基準電圧ｎとして与えるようにすればよい。

【００４６】比較器６０の出力端は本発明の第２のスイッチ手段に対応するスイッチ８８を介してバッファアンプ６４の入力端及びコンデンサＣsha の一端に接続されており、コンデンサＣsha の他端は接地されている。

【００４７】スイッチ８８、バッファアンプ６４及びコンデンサＣsha により自動光量制御終了時における比較器６０の出力電圧であるレーザダイオードＬＤ－Ａの駆動電流を制御するための制御電圧を保持する保持手段９０を構成している。保持手段９０は本発明の保持手段に対応している。

【００４８】スイッチ８８は、ＮＭＯＳトランジスタＮ１と、ソース・ドレイン間が短絡されＮＭＯＳトランジスタＮ１とバッファアンプ６４の入力端との間に接続されたノイズキャンセル用のＮＭＯＳトランジスタＮ２と、インバータ６２とを有している。ＮＭＯＳトランジスタＮ１のソースは比較器６０の出力端に、ドレインはＮＭＯＳトランジスタＮ２のソースに接続されている。ＮＭＯＳトランジスタＮ２のドレインはバッファアンプ６４の入力端に接続されている。ＮＭＯＳトランジスタＮ２はＮＭＯＳトランジスタＮ１とチャンネル長は等しくゲート幅が半分になるように設計されている。

【００４９】またＮＭＯＳトランジスタＮ１のゲートには直接、ＮＭＯＳトランジスタＮ２のゲートにはインバータ６２を介して、それぞれスイッチ８８のスイッチングを制御する制御信号ＡＰＣ－Ａが入力されるようになっている。尚、ＮＭＯＳトランジスタＮ１，Ｎ２のゲートへの制御信号はスイッチングノイズをできるだけ抑制するため、動作に影響しない範囲内で立ち上がり、立ち下がりを遅くした相補信号とすることが望ましい。

【００５０】またスイッチ８８がインバータ６２を除き、スイッチングノイズキャンセル用を含めＮＭＯＳトランジスタだけで構成されているため故障等でスイッチ８８がオフ状態のままとなり、コンデンサＣsha により比較器６０の出力の保持状態が長く続いてもその保持電圧は接地電位側に変動し、バッファアンプ６４の出力端に接続されたＮＭＯＳトランジスタＮ３に流れる電流は低下する。したがってレーザダイオードＬＤ－Ａの破壊や被照射面へのダメージを防ぐことができる。

【００５１】注意点としてはスイッチ８８がＮＭＯＳトランジスタだけで構成されているためスイッチの両端の電圧が１／２電源電圧以上にならないように電流出力用トランジスタのサイズを設計しなければならない。またドループを少しでも減らしたい場合は、比較器６０の出力電圧のサンプルホールド時の収束電圧がバッファアンプ６４に接続されたＮＭＯＳトランジスタＮ３の閾値電圧以上とならないようなＰＮ接合面積を持つＰＭＯＳトランジスタを接続してもよい。この場合少しでもＯＮ抵抗を下げたければＰＭＯＳトランジスタもスイッチとして駆動すればよいし、もしその必要がなければ単にＰＮ接合を持つソース・ドレインを短絡したＰＭＯＳトランジスタだけを接続することもできる。

【００５２】いずれにしてもスイッチ８８を二つのＭＯＳトランジスタで構成する場合には電源側に接続されるＭＯＳトランジスタのソース・ドレインのＰＮ接合面積と接地側に接続されるＭＯＳトランジスタのソース・ドレインのＰＮ接合面積との比がスイッチ８８がオフ状態にあり、レーザダイオードＬＤ－Ａが発光している時にレーザダイオードＬＤ－Ａの発光量が減少する方向に変化するように設定される。

【００５３】バッファアンプ６４は長時間、サンプルホールドが可能であるように少なくとも入力段はＭＯＳトランジスタで構成するのが望ましい。本実施の形態では、バッファアンプ６４は例えば、ＣＭＯＳトランジスタで構成された演算増幅器が用いられる。

【００５４】このように変調期間中にレーザダイオードＬＤ－Ａの駆動電流を制御するための比較器６０の出力電圧を保持する保持手段９０として、ＭＯＳトランジスタを用いて構成されたスイッチ８８と、少なくとも入力段がＭＯＳトランジスタで構成されたバッファアンプ６４とを使用した保持手段９０を用い、変調期間中の比較器６０の出力電圧の保持期間において保持手段９０のＭＯＳトランジスタで構成されたスイッチのソース・ドレインのＰＮ接合からの漏れ電流に起因するコンデンサＣsha により保持され電圧の変動が電流源８０、８２の出力電流を低下させる方向、すなわちレーザダイオードＬＤ－Ａが発光中であれば、その発光光量が減少する方向に変化するように設計することで自動光量制御信号が入って来なかった時にもレーザの破壊やあるいはレーザが長時間照射することで生じるレーザゼログラフィーの感光体の光疲労や、あるいは光記録であれば光媒体の劣化を防止することができる。

【００５５】さらに上記コンデンサＣsha をＩＣ内に作りこめれば、コンデンサＣsha を外部に接続した場合に比べ出力端子部の接合部の漏れや外部コンデンサのリークや外部コンデンサを実装するプリント基板上のリークなどを回避することができ保持手段（サンプルホールド回路）のドループ特性を従来のバイポーラを使用したものに比べ飛躍的に改善し、レーザダイオードアレーを駆動した際レーザダイオードの自動光量制御の間隔が広がることや、隣接したレーザダイオード同士で自動光量制御のタイミングが異なることによる光量ずれで画質が劣化するのを防止できる。

【００５６】バッファアンプ６４の出力端はＮＭＯＳトランジスタＮ３のゲートに接続され、ＮＭＯＳトランジスタＮ３のドレインは抵抗Ｒ６を介して接地されている。ＮＭＯＳトランジスタＮ３のソースはゲート・ドレ

イン間が短絡されたＰＭＯＳトランジスタＰ１のドレインに接続され、ＰＭＯＳトランジスタＰ１のソースは抵抗Ｒ５を介して電源Ｖccに接続されている。ＰＭＯＳトランジスタＰ１はカレントミラー回路を構成している。抵抗Ｒ６はサンプルホールドコンデンサＣshの電流リークによる電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５のゲートにおける電圧変動がレーザＬＤ－Ａの駆動電流に与える影響を緩和するために設けられている。仮に抵抗Ｒ６を設けないと、ＰＭＯＳトランジスタＰ２，Ｐ５のゲート電位の変動が二乗でドレイン電流、すなわち電流源８０、８２の出力電流に影響することになる。

【００５７】電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５のゲートにはコンデンサＣｉ－Ａが接続され、制御信号Ｐ０－Ａ，Ｐ１－Ａで電流スイッチ７６，７８がスイッチングされ、レーザダイオードＬＤ－Ａが強度変調された時にも電流源８０、８２の電流値が過渡的に変動しないようにしてある。この場合にＩＣチップ内にコンデンサＣｉ－Ａを形成する場合、大容量のものは得られないためこのコンデンサＣｉ－Ａの容量は、電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５のゲート・ドレイン間の合計容量の１６倍から２５６倍以内を目安に容量を決定する。例えば１６倍に設定すると、両方の電流源が同時にオン、オフしても電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５のゲート電圧の変動を１／１６に押さえることが可能になる

バッファアンプ６４の出力はＮＭＯＳトランジスタＮ３を駆動し、カレントミラー回路を構成するＰＭＯＳトランジスタＰ１によって電流源８０，８２を定電流駆動する。カレントミラー回路で電流を反転したのは、バッファアンプ６４を構成する演算増幅器を設計する際に入力のダイナミックレンジを接地電位を基準にする場合が多く、そのため演算増幅器をＭＯＳトランジスタで構成する場合にその差動入力段がＰＭＯＳトランジスタとなり、その結果電源電圧まで演算増幅器のダイナミックレンジを確保できないことによる。レーザゼログラフィーの場合、レーザダイオードの射出光の強度の変化は画像の濃度となって現れる。しかし大きく強度が変化する画像のエッジ部では絶対的な濃度の変動は視覚上大きな問題とはならない。しかし広い面積で濃度が変化すると視覚上も問題となるため本実施の形態ではカレントミラー回路の動作で電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５のゲート電圧が画像信号の一画素分の時間程度で初期値に戻るようにカレントミラー回路の出力インピーダンスを決定すれば問題ない。すなわち、電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５のゲートを、ＰＭＯＳトランジスタＰ２，Ｐ５のゲート・ドレイン間容量と付加容量との総容量との積として表わされる時定数が強度変調期間におけるおよそ一画素変調期間となるような出力インピーダンスを有するバッファアンプ６４で駆動することにより、コンデンサＣｉ－Ａで抑制することができない上記電流源のＰＭＯＳトランジスタＰ２，Ｐ５のゲート電位の変動をレーザダイオードＬＤ－Ａの強度変調の一画素期間内に留め、レーザゼログラフィに応用された場合の強度変調の精度低下による画質劣化を最小限に押さえることができる。ダミーロード７４がレーザダイオードＬＤ－Ａと特性が多少ずれていても精度低下を最小限にすることができる。

【００５８】カレントミラー回路を構成するＰＭＯＳトランジスタＰ１および電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５のソースと電源Ｖccとの間に接続された抵抗Ｒ５，Ｒ１，Ｒ２は電流源８０、８２の出力インピーダンスを高くするのに寄与している。バイポーラトランジスタをエミッタ接地でベースを電圧で駆動するとコレクタ電流がベース電位に対し指数関数的に増大するため、制御が難しく通常はエミッタに抵抗を入れ制御性をよくしている。

【００５９】しかしＭＯＳトランジスタではゲート電位に対しドレイン電流は二乗で変化するため特にソースに抵抗を入れる必要は無い。ＭＯＳトランジスタの相互コンダクタンスｇｍを大きくするためにＭＯＳトランジスタのチャンネル長を短くすると、ＭＯＳトランジスタで構成する定電流源の出力インピーダンスは低下する。これを補うにはＭＯＳトランジスタを多段にするなどの方法があるが電源電圧が低いと出力のダイナミックレンジが確保できない。そこで既述したように電流源８０、８２の出力インピーダンスがレーザダイオードＬＤ－Ａの変調動作時における微分抵抗の１６倍から２５６倍に大きくなるような抵抗Ｒ５、Ｒ１、Ｒ２を定電流源回路を構成するＰＭＯＳトランジスタＰ１，Ｐ２，Ｐ５のソースと電源Ｖccとの間に接続する。これにより１６レベルから２５６レベルの強度変調での精度と接続されるレーザダイオードＬＤ－Ａのための出力電圧のダイナミックレンジの両方をバランスよく確保することが可能になる。

【００６０】尚、制御信号Ｐ０－Ａ，Ｐ１－Ａ，ＡＰＣ－Ａ等（駆動回路Ａに関して）を入力する図示してない制御手段が本発明の制御手段に対応している。

【００６１】次に上記構成からなる本実施の形態に係るレーザダイオード駆動装置の動作を図２のタイムチャートを参照して説明する。最初に予めバイアス電源８４、８６にレーザタイオードＬＤ－Ａの閾値電流を設定しておく。駆動回路Ｂのバイアス電源についても同様である。最初に駆動回路Ａによってレーザダイオード ＬＤ－Ａの自動光量制御を行う。先ず時刻ｔ１で制御信号ＡＰＣ－Ａがハイレベルになると、スイッチ８８がオン状態となり、保持手段９０がサンプリングモードになり、比較器６０の出力電圧がコンデンサＣsha に充電可能な状

態となる。

【００６２】また時刻ｔ１で制御信号Ｐ０－Ａ，Ｐ１－Ａがハイレベルになることにより電流スイッチ７６、７８を構成するＰＭＯＳトランジスタＰ３，Ｐ６がオン状態、ＰＭＯＳトランジスタＰ４，Ｐ７がオフ状態となり、この結果、レーザダイオードＬＤ－Ａには電流源８０、８２より電流ＩＬＤ－Ａが供給され、レーザダイオードＬＤ－Ａは発光する。このレーザダイオードＬＤ－Ａの射出光は、フォトダイオードＰＤにより受光され、フォトダイオードＰＤはレーザダイオードＬＤ－Ａの発光光量に応じた光電流を出力する。この光電流は抵抗Ｒ７により電圧に変換され、レーザダイオードＬＤ－Ａの発光量を監視するためのモニタ電圧ＶPDとして比較器６０の反転入力端子に入力される。比較器６０の非反転入力端子にはレーザダイオードＬＤ－Ａの自動光量制御における発光量の目標値を設定するための基準電圧Ｖr1が基準電源１００より入力される。

【００６３】比較器６０は、基準電圧Ｖr1とモニタ電圧ＶPDとを比較し、その偏差に応じた電圧をスイッチ８８を介してバッファアンプ６４に出力する。この結果、コンデンサＣsha は比較器６０の出力電圧により充電される。コンデンサＣsha の充電電圧がバッファアンプ６４よりＮＭＯＳトランジスタＮ３のゲートに出力され、ＮＭＯＳトランジスタＮ３、カレントミラー回路を構成するＰＭＯＳトランジスタＰ１が駆動され、ＰＭＯＳトランジスタＰ１により電流源８０、８２を構成するＰＭＯＳトランジスタＰ２，Ｐ５が定電流駆動される。

【００６４】モニタ電圧ＶPDは基準電源１００により設定された基準電圧Ｖr1に一致するまで上昇し、その後、時刻ｔ２で制御信号ＡＰＣ－Ａがローレベルになると、スイッチ８８を構成するＮＭＯＳトランジスタＮ１がオフ状態となり、コンデンサＣsha に自動光量制御終了時の比較器６０の出力電圧が保持される。

【００６５】また時刻ｔ２で制御信号Ｐ０－Ａ，Ｐ１－Ａがローレベルになることにより電流スイッチ７６、７８を構成するＰＭＯＳトランジスタＰ３，Ｐ６がオフ状態、ＰＭＯＳトランジスタＰ４，Ｐ７がオン状態となり、この結果、これまで電流源８０、８２よりレーザダイオードＬＤ－Ａに供給されていた電流ＩLD-Aはダミーロード７４に供給され、レーザダイオードＬＤ－Ａは消灯し、フォトダイオードＰＤの受光光量も零となるのでモニタ電圧ＶPDも零になる。

【００６６】次に時刻ｔ３で制御信号Ｐ０－Ａがハイレベルになると、電流スイッチ７６を構成するＰＭＯＳトランジスタＰ３がオン状態になるので、電流源８０の出力電流（１×Ｉ）がレーザダイオードＬＤ－Ａに供給され、レベル１の強度変調が行われる。このとき電流スイッチ７６のＰＭＯＳトランジスタＰ４，電流スイッチ７８のＰＭＯＳトランジスタＰ６はオフ状態、電流スイッチ７８のＰＭＯＳトランジスタＰ７はオン状態になるのでダミーロード７４には電流源８２から２×Ｉの電流が供給される。

【００６７】また時刻ｔ４で制御信号Ｐ０－Ａがローレベルになり、制御信号Ｐ１－Ａがハイレベルになると、電流スイッチ７６のＰＭＯＳトランジスタＰ３がオフ状態、ＰＭＯＳトランジスタＰ４がオン状態、電流スイッチ７８のＰＭＯＳトランジスタＰ６がオン状態、ＰＭＯＳトランジスタＰ７がオフ状態になるので、電流源８２の出力電流（２×Ｉ）がレーザダイオードＬＤ－Ａに供給され、レベル２の強度変調が行われる。このときダミーロード７４には電流源８０より（１×Ｉ）の電流が供給される。

【００６８】更に時刻ｔ５で制御信号Ｐ０－Ａがローレベルの状態からハイレベルになり、制御信号Ｐ１－Ａがハイレベルの状態のまま維持されると、電流スイッチ７６のＰＭＯＳトランジスタＰ３がオン状態、ＰＭＯＳトランジスタＰ４がオフ状態、電流スイッチ７８のＰＭＯＳトランジスタＰ６がオン状態、ＰＭＯＳトランジスタＰ７がオフ状態になるので、電流源８０の出力電流（１×Ｉ）及び電流源８２の出力電流（２×Ｉ）がレーザダイオードＬＤ－Ａに供給され、レベル３の強度変調が行われる。このときダミーロード７４にはバイアス電源８６のＰＭＯＳトランジスタＰ９より所定のバイアス電流のみが供給される。時刻ｔ６で制御信号Ｐ０－Ａ、Ｐ１－Ａが共にハイレベルからローレベルになると、電流スイッチ７６のＰＭＯＳトランジスタＰ３がオフ状態、ＰＭＯＳトランジスタＰ４がオン状態、電流スイッチ７８のＰＭＯＳトランジスタＰ６がオフ状態、ＰＭＯＳトランジスタＰ７がオン状態になるので、電流源８０、８２の出力電流はすべてダミーロード７４に流れ、レーザダイオードＬＤ－Ａにはバイアス電源８４より閾値電流Ｉthが供給されるだけであり、時刻ｔ２～ｔ３の期間と同じレベル０の強度変調がなされる。レーザダイオードＬＤ－Ａに流れる電流ＩＬＤ－Ａの変化に応じて抵抗Ｒ７より比較器６０の反転入力端子に入力されるモニタ電圧ＶPDも変化する。

【００６９】時刻ｔ７以降では、駆動回路Ｂによりレーザダイオードしｄ－Ｂの自動光量制御及び自動光量制御の後の強度変調動作が行なわれるが、駆動回路Ａによりレーザダイオードしｄ－Ａについて時刻ｔ１～ｔ６で行なわれた自動光量制御及び強度変調動作と内容が同一であるので説明を省略する。

【００７０】以上述べたように、本発明の実施の形態によれば、複数の電流源の各々を構成するＰＭＯＳトランジスタのソースと電源との間にレーザダイオードの動作時における微分抵抗から算出した適切な抵抗を接続することで、強度変調時の精度を確保しつつ出力電圧のダイナミックレンジも確保することが可能になる。

【００７１】また駆動回路と制御電圧の保持回路をＣＭＯＳトランジスタで作製するためＰＭＯＳトランジスタ

を用いて吐き出し電流源を作ることも容易で、特にレーザダイオードアレーのようにカソードが共通に接続され吐き出し電流源が必要な場合、吸い込み電流源と吐き出し電流源を組み合せた従来の吐き出し電流源に比べ低ノイズ、高速、低コストの駆動回路を得ることができると共にMOSトランジスタのハイインピーダンス性により外付けのコンデンサを用いることなしに制御電圧の保持特性を改善することができる。

【0072】更に電流源を構成するPMOSトランジスタのゲートと電源との間に電流源を構成するPMOSトランジスタのゲート・ドレイン間の総容量より十分、大きい容量を有するコンデンサを接続することにより、強度変調時に電流源がオン、オフする際生じる電流源を構成するPMOSトランジスタのゲート電位の変動を抑制することができる。

【0073】また電流スイッチのレーザ接続側と、逆側に接続したレーザダイオードと直流の電圧電流特性及び動作点でのインピーダンスが略、等しいダミーロードを接続することにより電流源を構成するPMOSトランジスタのドレイン電位の変動を小さくすることができ、そして複数の電流源の各々を構成するPMOSトランジスタのゲートを、これらのPMOSトランジスタのゲート・ドレイン間容量と付加容量との総容量との積で表される時定数がレーザ変調期間のおよそ一画素変調期間となるような出力インピーダンスを有するバッファで駆動することにより上記ゲート電位の変動防止用のコンデンサで押さえきれない電流源を構成するPMOSトランジスタのゲート電位の変動をレーザ変調の一画素変調期間内にとどめレーザゼログラフィーに応用された場合の強度変調の精度低下による画質劣化を最小限に押さえることができる。

【0074】更にレーザダイオードアレーで必要なレーザダイオード毎の個別の基準電位を、一つの基準電位を一つの駆動回路の比較器の基準電位とし、その他の駆動回路の比較器の基準電位は、それぞれ先に与えた一つの基準電位が接続された比較器を含む光量制御系のオフセットと、その他の各駆動回路の比較器を含む各光量制御系とのオフセット差分を先の基準電位に加えて与えるようにしたので、最初にオフセットの差分を設定しておけば、その後は上記一つの基準電位のみを調整することでレーザダイオードアレーのすべてのレーザダイオードの出力光量を正確に制御することができる。

【0075】

【発明の効果】以上に説明したように請求項1に記載の発明によれば、レーザダイオードを駆動するための駆動電流を供給する複数の電流源の各々を、MOSトランジスタと該MOSトランジスタのソースと接地または電源との間にそれぞれ抵抗を接続して構成し、前記複数の電流源の各々を構成するMOSトランジスタと前記抵抗においてトランジスタ比W／Lと前記抵抗の抵抗値の逆数との比が同じであり、かつレーザダイオード側から見た前記複数の電流源の出力抵抗値がレーザダイオードを駆動可能で変調動作時の前記レーザダイオードの微分抵抗値より十分大きくなる値にしたので、レーザダイオードの駆動電流を強度変調する際にレーザダイオードの端子間電圧の変動による駆動電流の出力変動を抑制でき、レーザダイオードの強度変調精度の向上が図れると共に、前記抵抗による電圧降下を最小にできるのでレーザダイオードの端子間電圧が大きいレーザダイオードにも対応することが可能になる。

【0076】また請求項2に記載の発明によれば、複数の電流源をそれぞれ、2つのMOSトランジスタで構成される差動型電流スイッチを用いてレーザダイオードを駆動する駆動電流を強度変調する際に、上記各差動型電流スイッチを駆動しても前記電流源を構成するMOSトランジスタのドレイン・ゲート間の総容量より十分、大きい容量を有するコンデンサを複数の電流源の各々を構成するMOSトランジスタのゲートと接地または電源との間に接続し、かつ二つの電流切換スイッチ手段の各々を構成する二つのMOSトランジスタの一方のMOSトランジスタのドレインにレーザダイオードと直流の電圧電流特性及び動作点でのインピーダンスが略等価な負荷を接続することにより複数の電流源の各々を構成するMOSトランジスタのゲートの電圧変動を抑制することができるので、強度変調の精度の向上が図れる。

【0077】更に請求項3に記載の発明によれば、発光しているレーザが万が一制御系の停止などによって保持手段により比較手段の出力が保持される状態が変調期間外まで継続しても変調期間内においてレーザダイオードの発光量が減少する方向に保持手段の保持電圧が変化するため、過電流によりレーザダイオードが破壊したり、またはレーザダイオードの被照射面が損傷を受けるのを防止できる。

【0078】また請求項4に記載の発明によれば、複数のレーザダイオードのうちのいずれか一つのレーザダイオードの光量制御のための一つの基準電圧を該一つのレーザダイオードを駆動するレーザダイオード駆動装置の比較手段に与え、残りの他のレーザダイオードを駆動するレーザダイオード駆動装置の各比較手段へはそれぞれ、前記一つの基準電圧に該基準電圧が与えられる比較手段の入力オフセット電圧と前記残りの他の各レーザダイオードを駆動するレーザダイオード駆動装置の各比較手段の入力オフセット電圧との差を加えた値を基準電圧として与え、後は上記一つの基準電圧のみを調整することですべてのレーザダイオードの光量調整を高精度に行うことができる。

【図面の簡単な説明】

【図1】　本発明の実施の形態に係るレーザダイオード駆動装置の構成を示す回路図。

【図2】　図1に示したレーザダイオード駆動装置の動

作を説明するためのタイムチャート。

【図３】　吐き出し型電流源を用いた従来のレーザダイオード駆動装置の要部の構成を示す回路図。

【図４】　複数の吐き出し型電流源を用いた従来のレーザダイオード駆動装置の要部の構成を示す回路図。

【図５】　ＰＭＯＳトランジスタを利用した従来のレーザダイオード駆動装置の要部の構成を示す回路図。

【図６】　ＭＯＳトランジスタを用いたサンプルホールド回路の構成例を示す回路図。

【図７】　サンプルホールド回路における制御電圧保持状態でのコンデンサ側のスイッチ端子における収束電圧とスイッチを構成するＭＯＳトランジスタの電源側と接地側のＰＮ接合面積比との関係を示す説明図。

【符号の説明】

ＬＤ－Ａ　レーザダイオード　　ＬＤ－Ｂ　レーザダイオード

ＰＤ　フォトダイオード　　６０　比較器

６２　インバータ　　６４　バッファアンプ

６６　インバータ　　６８　インバータ

７０　インバータ　　７２　インバータ

７６　電流スイッチ　　７８　電流スイッチ

８０　電流源　　８２　電流源

８４　バイアス電流源　　８６　バイアス電流源

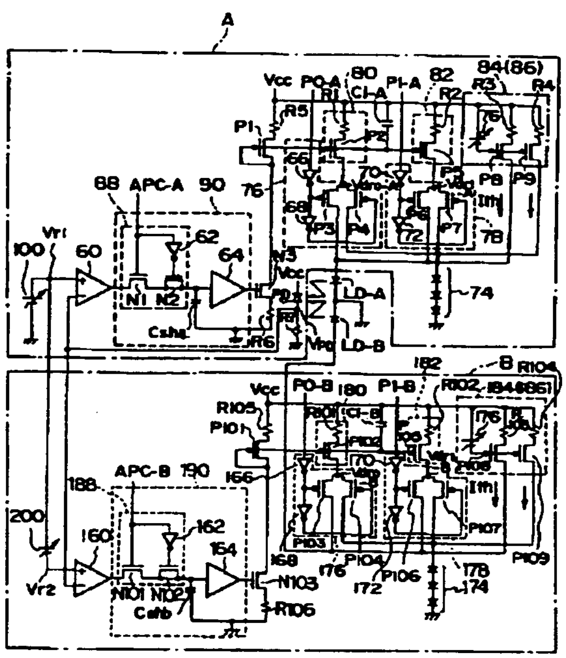
８８　スイッチ９０

９０　駆動電流制御電圧保持手段

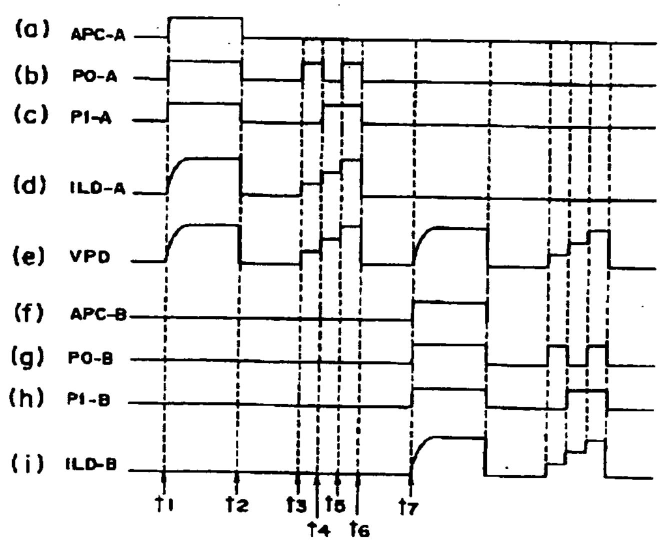
１００　基準電源　　１６０　比較器

２００　基準電源

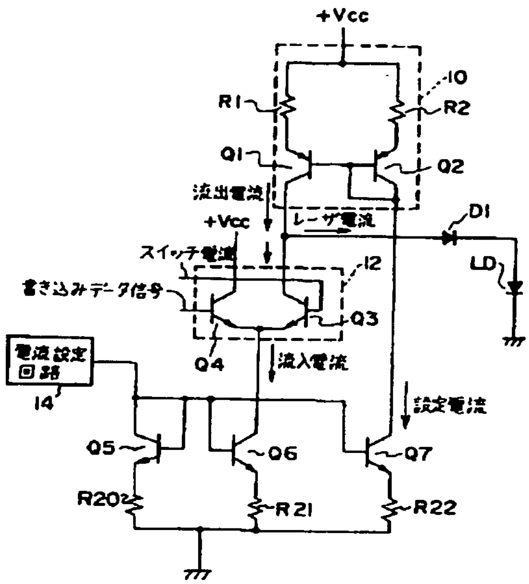
【図１】



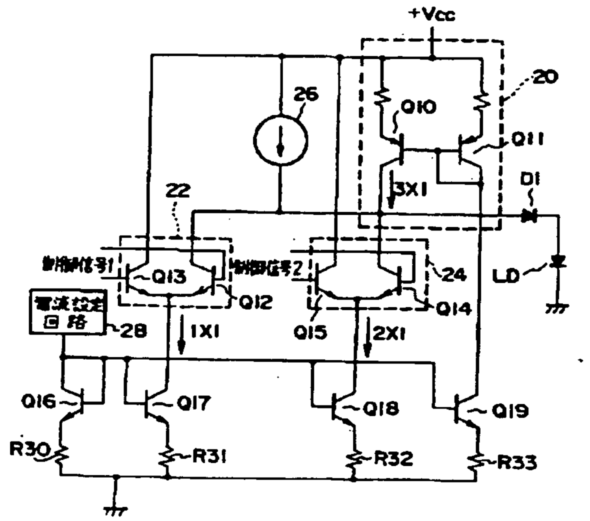
【図２】



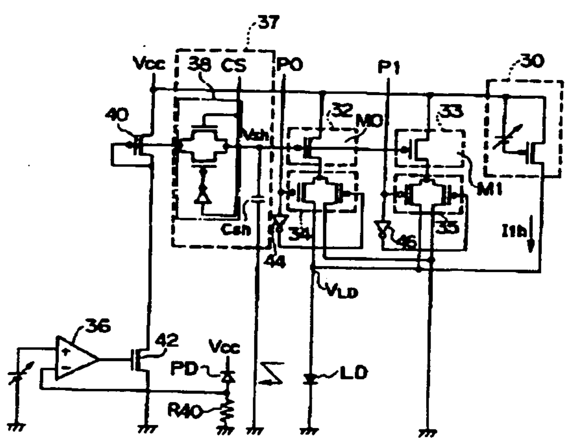
【図3】


+Vcc
10
R1
R2
Q1
Q2
流出電流
レーザ電流
D1
+Vcc
LD
スイッチ電流
12
書き込みデータ信号
Q3
Q4
流入電流
電流設定回路
14
設定電流
Q5
Q6
Q7
R20
R21
R22

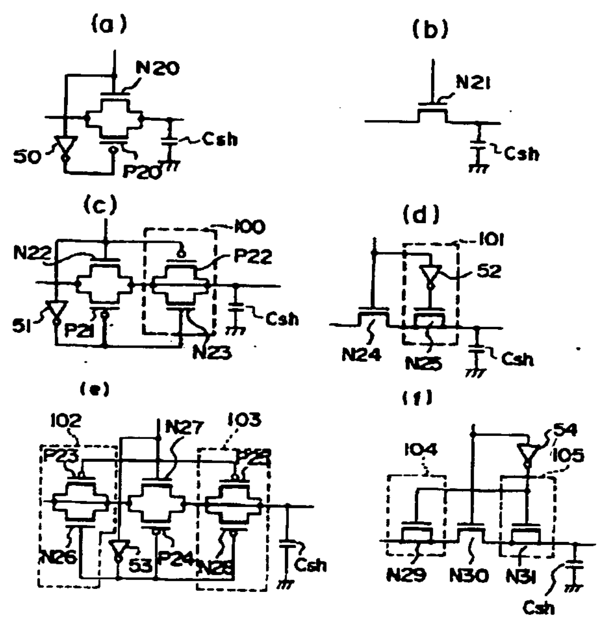
【図4】


+Vcc
26
20
Q10
Q11
3XI
D1
22
制御信号1
Q13
Q12
制御信号2
24
Q14
LD
電流設定回路
28
1XI
Q15
2XI
Q16
Q17
Q18
Q19
R30
R31
R32
R33

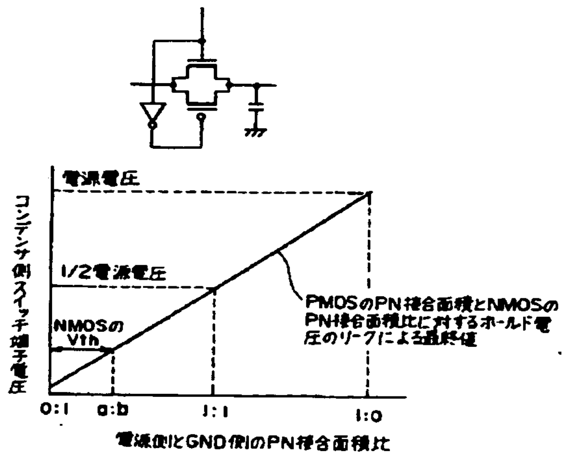
【図5】


37
Vcc
38
CS
P0
P1
30
40
32
M0
33
Vsh
M1
Csh
34
46
35
Ith
44
VLD
36
42
Vcc
PD
LD
R40

【図6】


(a)
N20
Csh
50
P20
(b)
N21
Csh
(c)
100
N22
P22
51
P21
Csh
N23
(d)
101
52
N24
N25
Csh
(e)
102
N27
103
P23
P25
N26
53
P24
N28
Csh
(f)
54
104
105
N29
N30
N31
Csh

【図７】


電源電圧
1/2電源電圧
NMOSの
Vth
コンデンサ側スイッチ端子電圧
PMOSのPN接合面積とNMOSのPN接合面積比に対するホールド電圧のリークによる最終値
0:1
a:b
1:1
1:0
電源側とGND側のPN接合面積比